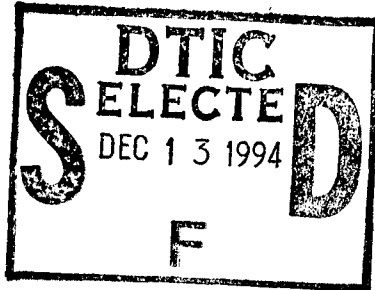


6798-EN-01

DTIC

BACKSCATTER AND TRANSMISSION OF AEROSOL AT UV  
THROUGH MIDDLE IR WAVELENGTHS



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Galway.

CONTRACT NUMBER : DAJA45-92-C-0024

6th Interim Report

July 1994 - September 1994

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13. ABSTRACT (Maximum 200 words) The total biological pollen and spore number concentration, per m <sup>3</sup> , at the Mace Head Environmental field research station on the west coast of Ireland is presented for consecutive months from September 1993 to June 1994 using a continuous (with a resolution of 4 hours) Burkard volumetric spore sampler. Pollen grain and spore concentration per m <sup>3</sup> are also presented for individual taxa (species). The biological aerosol concentration for clean (maritime), polluted (continental) and modified maritime air flows are interpreted with the support of the locally measured wind direction data together with air flow back trajectories from the Mace Head site.				
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**Measurement of Biological aerosol (pollen and spores) using a Burkard continuous volumetric sampler at the Mace Head field station, on the west coast of Ireland.**

The Burkard volumetric trap at the Mace Head Environmental Research Station has been used to obtain pollen and spore grain concentration per  $\text{m}^3$  of air. The total concentration values obtained from the Burkard trap are interpreted with the support of air parcel back trajectory and wind direction data.

**Plotting the results from the Burkard trap**

The raw data is entered into a QUATTROPRO file and converted to concentrations  $\text{m}^{-3}$  as described in Interim report 4. These files are converted to ACSII files and imported onto the VAX 6610 mainframe computer in University College Galway. The QDP package on the VAX mainframe is used to plot the number concentrations of pollen and spores per unit volume against time. Time is expressed as the Julian date added to the fraction of the day. The data is plotted on a monthly basis and a plot of the total pollen and spore concentration for each month has been obtained.

**Monthly plots of pollen and spore concentration  $\text{m}^{-3}$  from September 1993 to June 1994**

The pollen and spore concentrations for individual taxa are plotted in the odd numbered figures from Figure 1 to Figure 19 for consecutive months from September 1993 to June 1994. The total pollen and spore concentrations are plotted in the even numbered figures from Figure 2 to Figure 20 for the same period. Data from some of the dates during this period is not presented here. The data has been deemed to be unreliable in cases where experimental faults have caused an interference with data collection, for instance in the case of loss of power to the vacuum pump of the Burkard trap.

The pollen and spore concentrations for individual taxa for the month of September 1993 can be seen in Figures 1(a),(b),(c),(d) and (e). In each figure, several taxa are plotted separately and stacked vertically. Each plot shares the same time scale, which is the Julian date. Each "+" indicates one data point, ie. the concentration of that taxa at that time (fraction of a day) on that Julian date. It can be seen that for many taxa, the data points are at zero most of the time, and this will be discussed later in this report. The taxa in each plot are labelled along the vertical axis. The concentration per  $\text{m}^3$  is given on the vertical scale. All of the taxa found at each data point were added to give the total pollen and spore

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concentration. The total pollen and spore concentration  $\text{m}^{-3}$  for the month of September 1993 is plotted in Figure 2. The method of presentation described here for the month of September 1993 is similar to every month plotted from September 1993 to June 1994.

### **Combined plots of total concentrations**

The total pollen and spore counts for the months March through June 1993 are plotted in Figure 21. Figure 21(a) has also been included here. It is the same plot as shown Figure 5.21, except for the exclusion of one data point. Due to one data point of high pollen and spore concentration  $\text{m}^{-3}$  in Figure 21, other data points have been obscured by the scale of the y-axis. To compensate for this, Figure 21(a) is included. This plot is the same as that presented in Figure 21 except that one data point has been deleted. A pollen and spore concentration of over 3,400 grains  $\text{m}^{-3}$  was found for the sample on the 25 June 1993 at 04:00. An insect was found on the slide, which had impacted onto the Melinex tape of the Burkard drum. The impaction caused grains to spray from the legs and wings of the insect. This is the cause of the abnormally high concentration of grains. The total pollen and spore counts of the months July through December 1993 are plotted in Figure 22. The total pollen and spore counts of the months January through June 1994 are plotted in Figure 23.

### **Interpretation of biological aerosol concentration using air parcel back trajectory and wind direction data**

Wind direction data is presented in this section. The horizontal axis in these plots represents the Julian date. The vertical axis gives the wind direction measured in degrees. Due North is  $0^\circ$  and  $90^\circ$  is due East on this scale. At the Mace Head Environmental Research Station, a wind direction within the range of  $180^\circ$  to  $300^\circ$  is indicative of clean air, i.e. that which has come from the direction of the Atlantic ocean without passage overland, in general. Air parcel back trajectory data are also presented in this section. Each figure is labelled "4 d back trajectories 925 hPa" indicating that 925 mbar back trajectories are calculated for four days. Marks on the trajectories indicate one day travel. The back trajectories shown for Mace Head are marked with an "x". The time of the arrival of the parcel is labelled on the top of each figure as date, month, year, and time of day. Representative examples of pollen and spore events associated with maritime, direct European continental and modified maritime air flows are now presented.

The effect of wind direction from a clean air sector on pollen and spore total

concentration  $\text{m}^{-3}$  is now discussed. Figure 24(a) shows the total pollen and spore concentration  $\text{m}^{-3}$  for the month of March 1994. It is seen that a zero concentration of pollen and spores  $\text{m}^{-3}$  was detected on the 7 March 1994 (Julian date 66). The wind direction for this date is presented in Figure 24(b). It can be seen that the wind direction is from the clean air sector. The four day back trajectory (Figure 24(c)) for 12:00 noon on 7 March 1994 (equivalent to Julian date 66) shows that the air parcel has passed over the Atlantic ocean. A pollen or spore cloud which travels over a body of water cannot increase its concentration by a local source. The aerobiological cloud becomes increasingly dilute by mixing with surrounding air. The longer a pollen or spore cloud travels over a body of water, the more likely the particles are becoming dispersed completely.

The effect of wind direction from a non-clean air sector is now examined. Figure 25(a) shows the total pollen and spore concentration  $\text{m}^{-3}$  for the month of May 1994. The Julian date 138 (May 18, 1994) shows a peak of over 150 grains  $\text{m}^{-3}$ . The wind direction for this date is presented in Figure 25(b). It is seen that the wind direction is from the non-clean air sector between  $50^\circ$  and about  $170^\circ$ . The four day back trajectory (Figure 25(c)) for 12:00pm on 18 May 1994 (equivalent to Julian date 138) shows that the air parcel has passed over Ireland and Great Britain. The air parcel has been able to increase its pollen and spore concentration by local source plants.

The effect of a modified air parcel which has crossed Ireland and a body of water is described as follows. Figure 26(a) shows the total pollen and spore concentration  $\text{m}^{-3}$  for the month of November 1993. The Julian date 332 shows a pollen and spore concentration of over 20 grains  $\text{m}^{-3}$ . The wind direction for this date is presented in Figure 26(b). It can be seen that the wind direction is from a non-clean air sector. The four day back trajectory (Figure 26(c)) for 12:00pm on 28 November 1993 (equivalent to Julian date 332) shows that the air parcel has passed a section of the Atlantic ocean and then a southern portion of Ireland, before arriving at Mace Head. The passage of the air parcel over the body of water would have dispersed the pollen and spore content. The passage over Ireland would have provided a local source. The total pollen and spore concentration  $\text{m}^{-3}$  value observed can be attributed to the combination of these features of the back trajectory.

#### **Further research possible with the results obtained**

The Burkard volumetric trap has been shown to provide information on extremely low pollen and spore concentrations per  $\text{m}^3$ . It is an instrument which is convenient to use and

its applications are numerous. It can be used to compare total biological aerosol concentration with respect to meteorological influences. It is possible by this method to detect grains which originated from plants alien to the local environment and conclusions could be drawn about long distance dispersal of the taxa in this case.

The Burkard volumetric trap was placed at Mace Head Environmental Research Station and the results obtained are given in terms of pollen and spore grain concentration per m<sup>3</sup> of air. The total concentration values obtained with the Burkard volumetric trap have been interpreted with the support of air parcel back trajectory and wind direction data at the Mace Head Environmental Research Station.

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Figure 1(a)

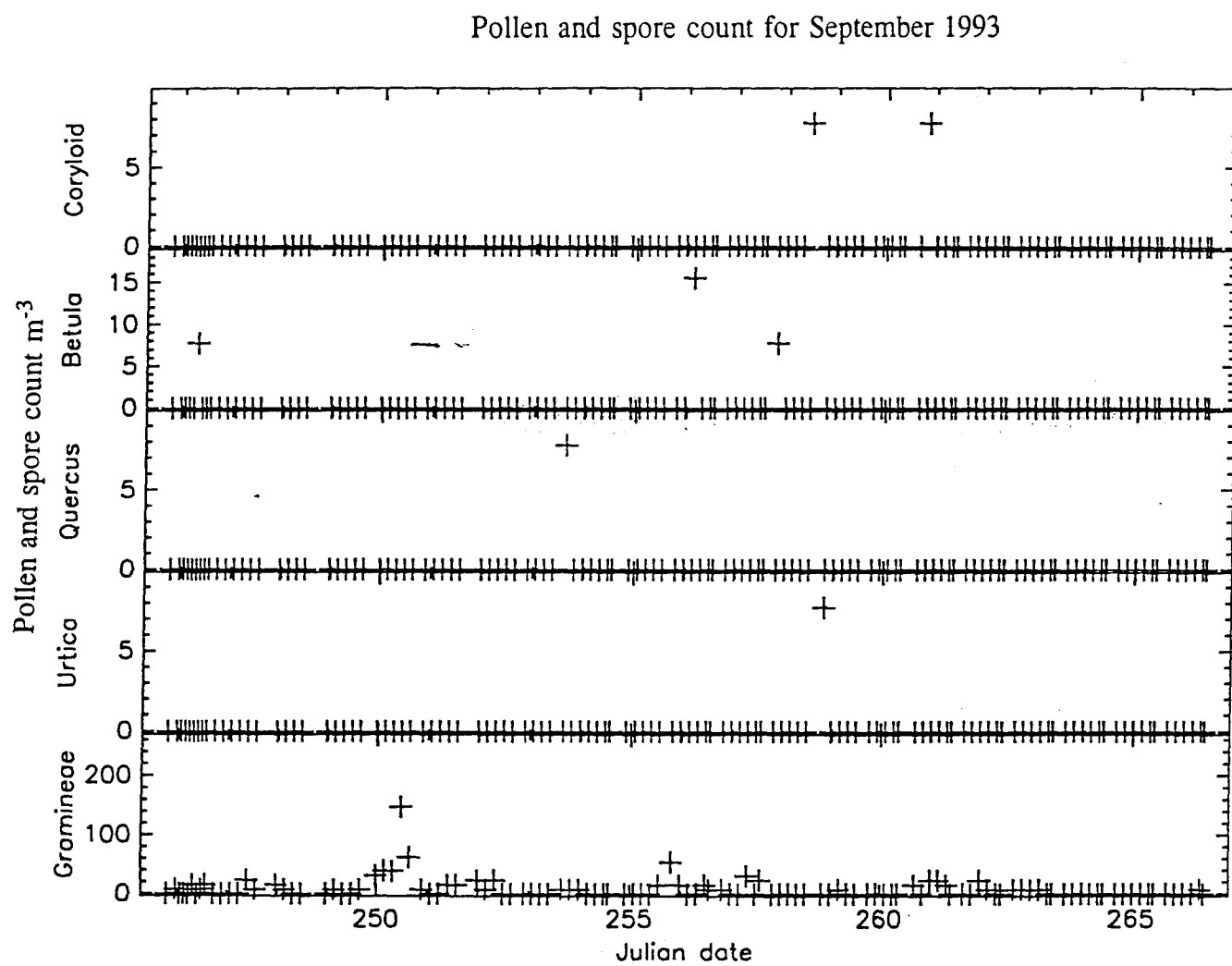


Figure 1(b)

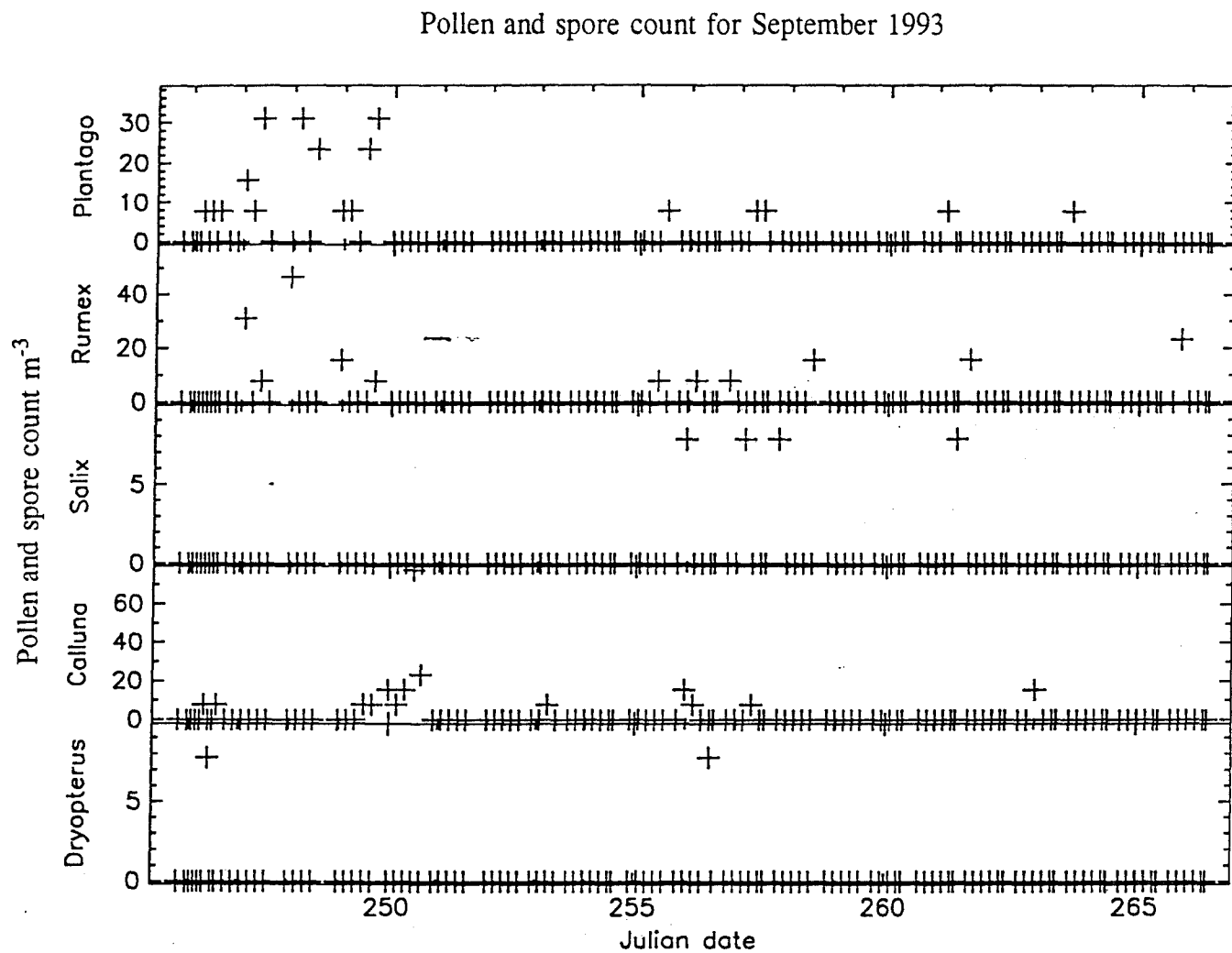




Figure 1(c)

Pollen and spore count for September 1993

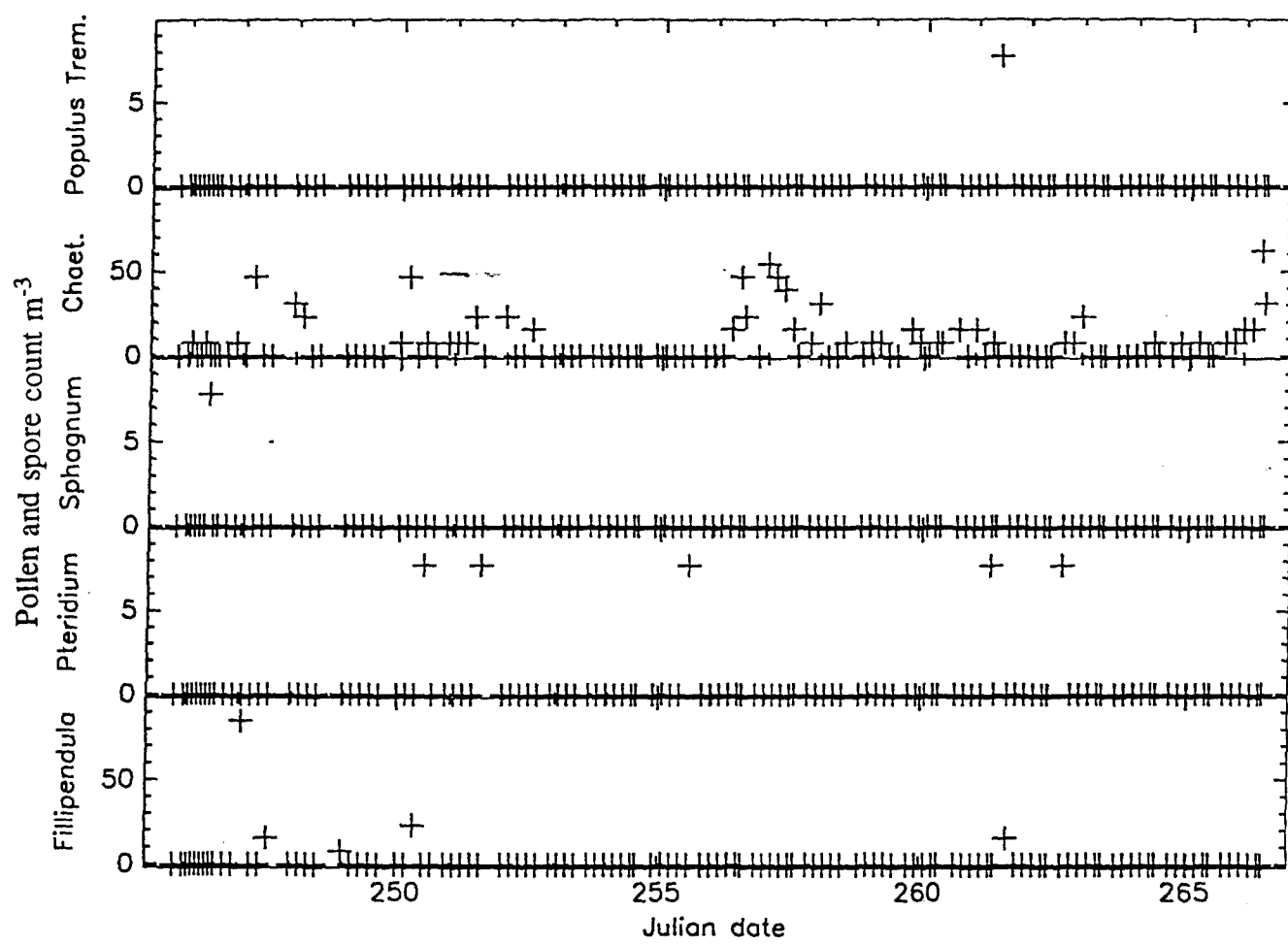


Figure 1(d)

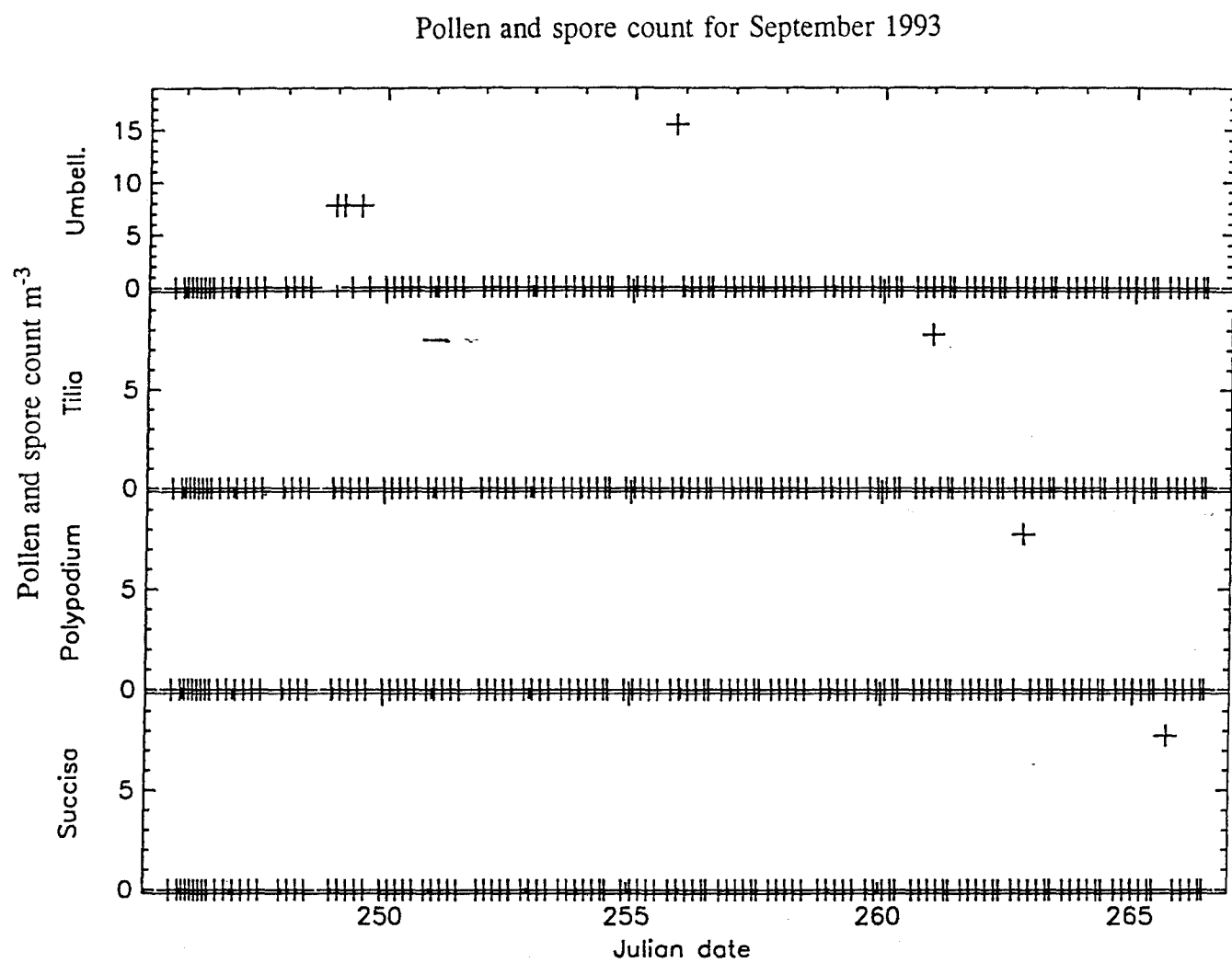


Figure 1(e)

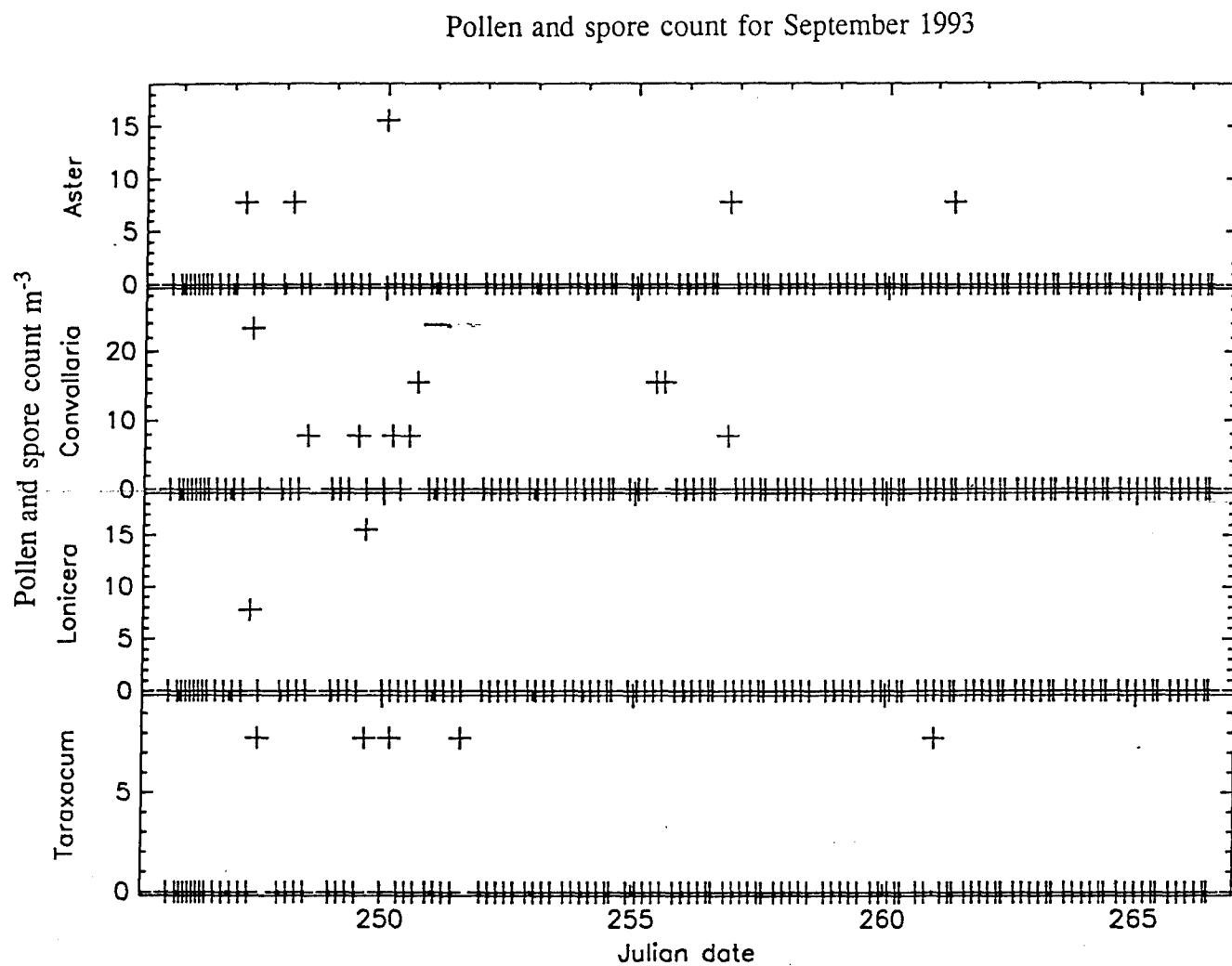


Figure 2

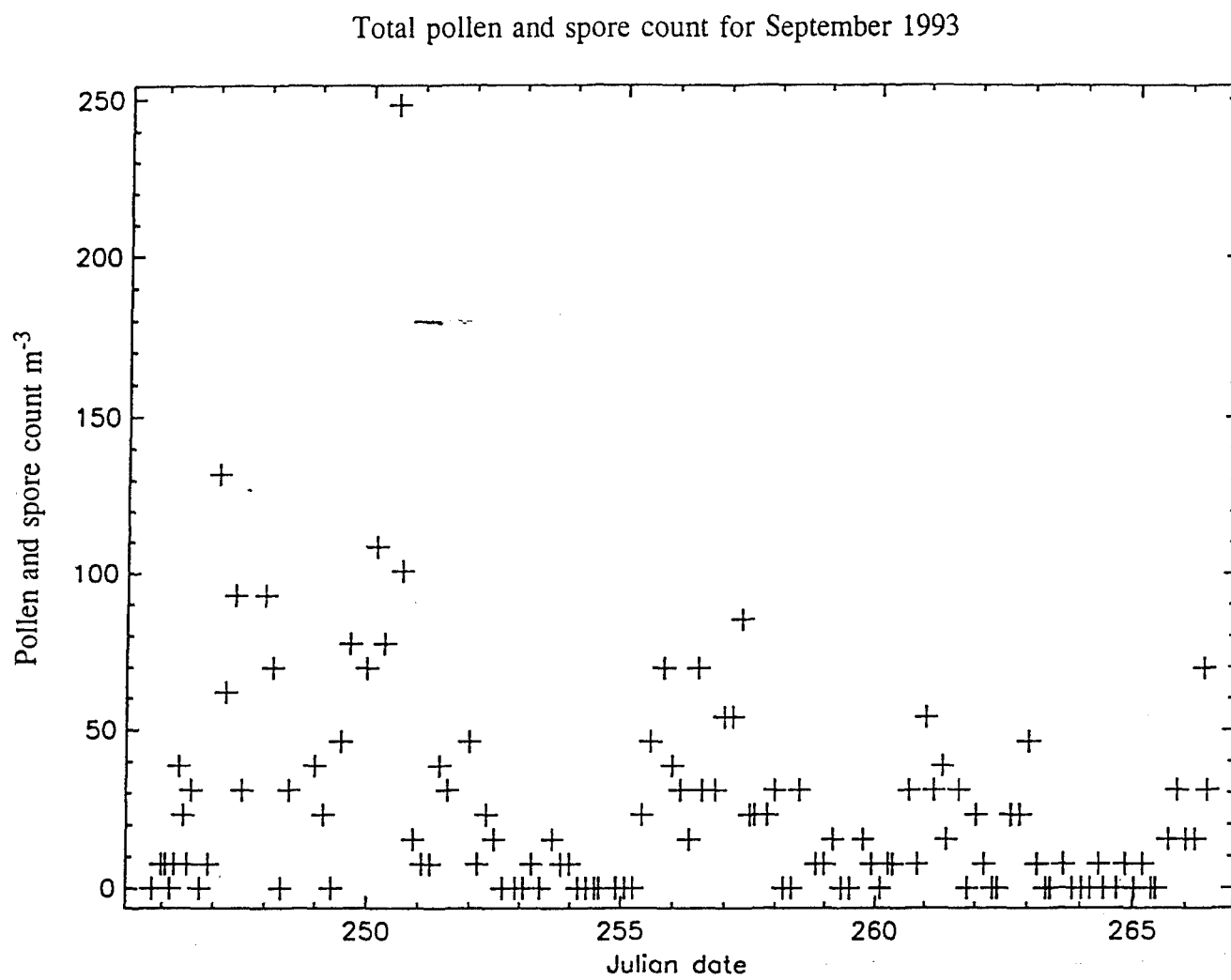


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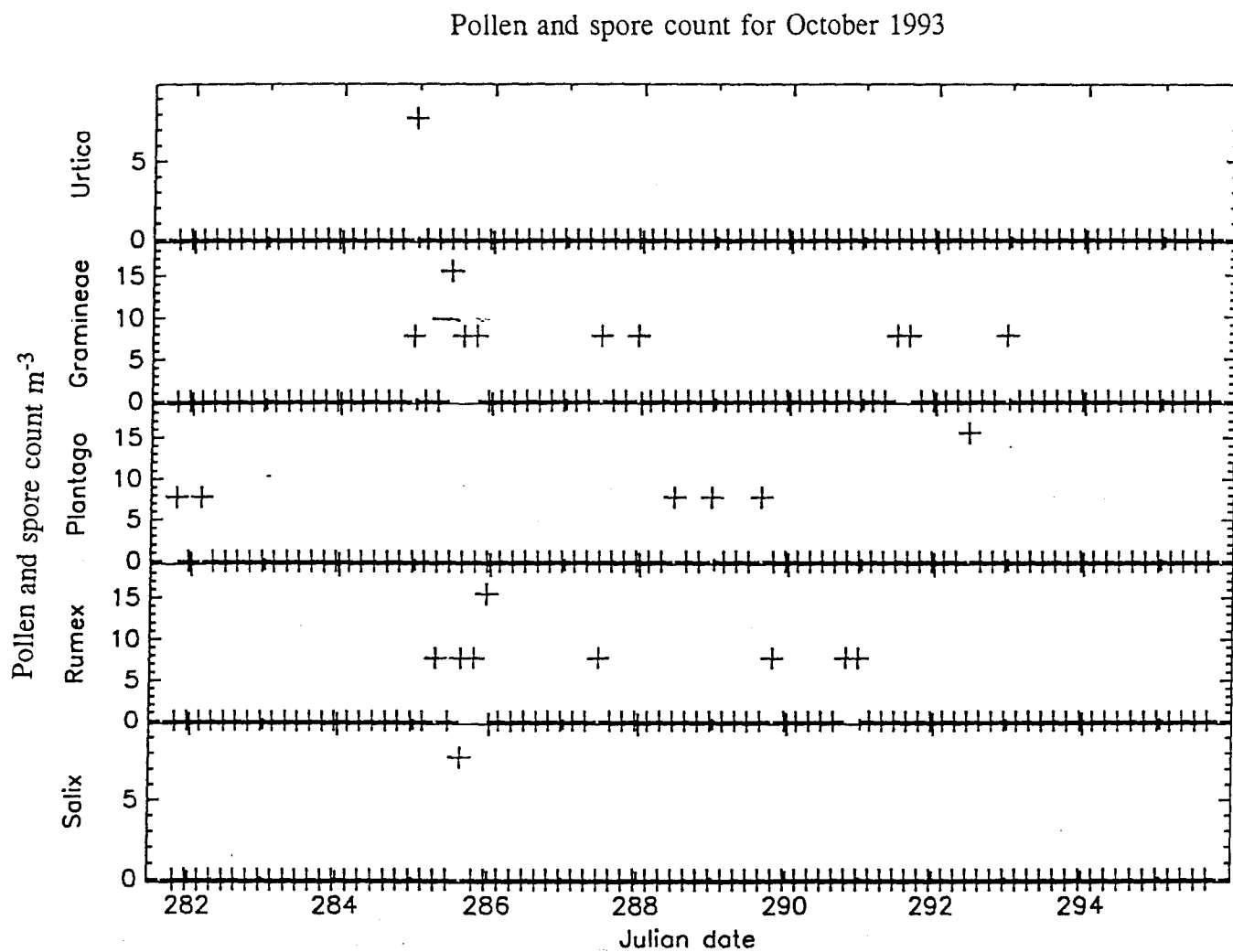


Figure 3(b)

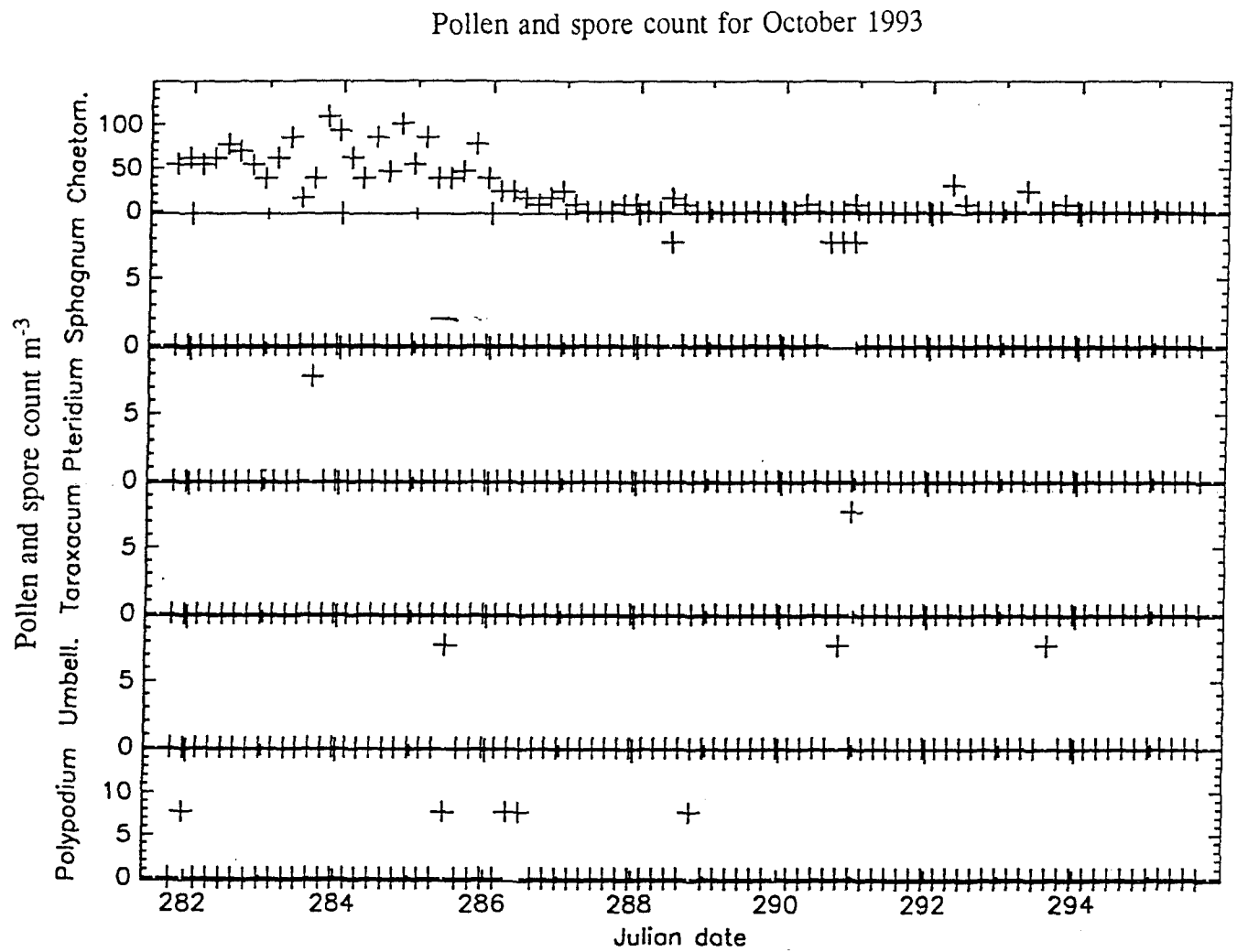


Figure 4

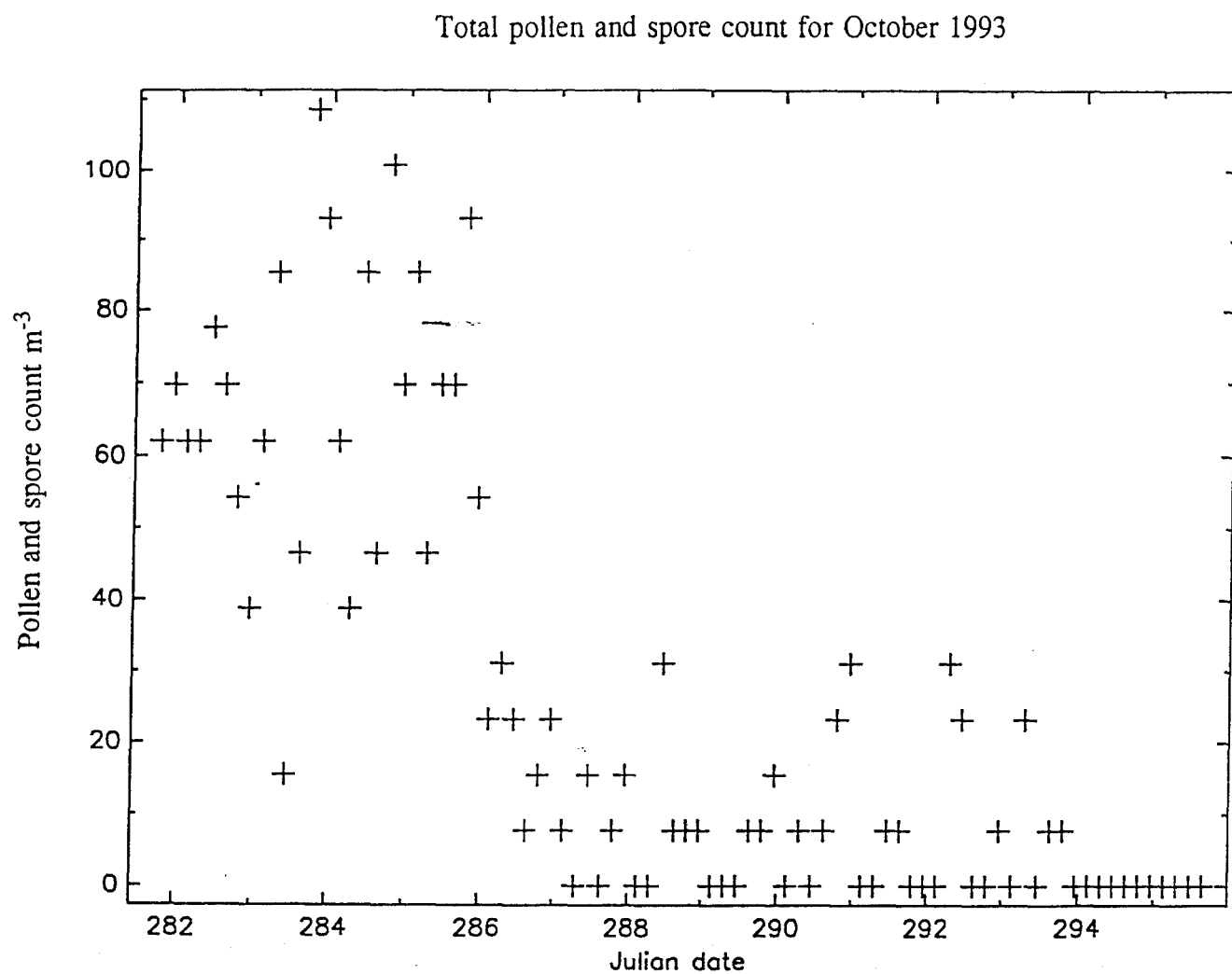


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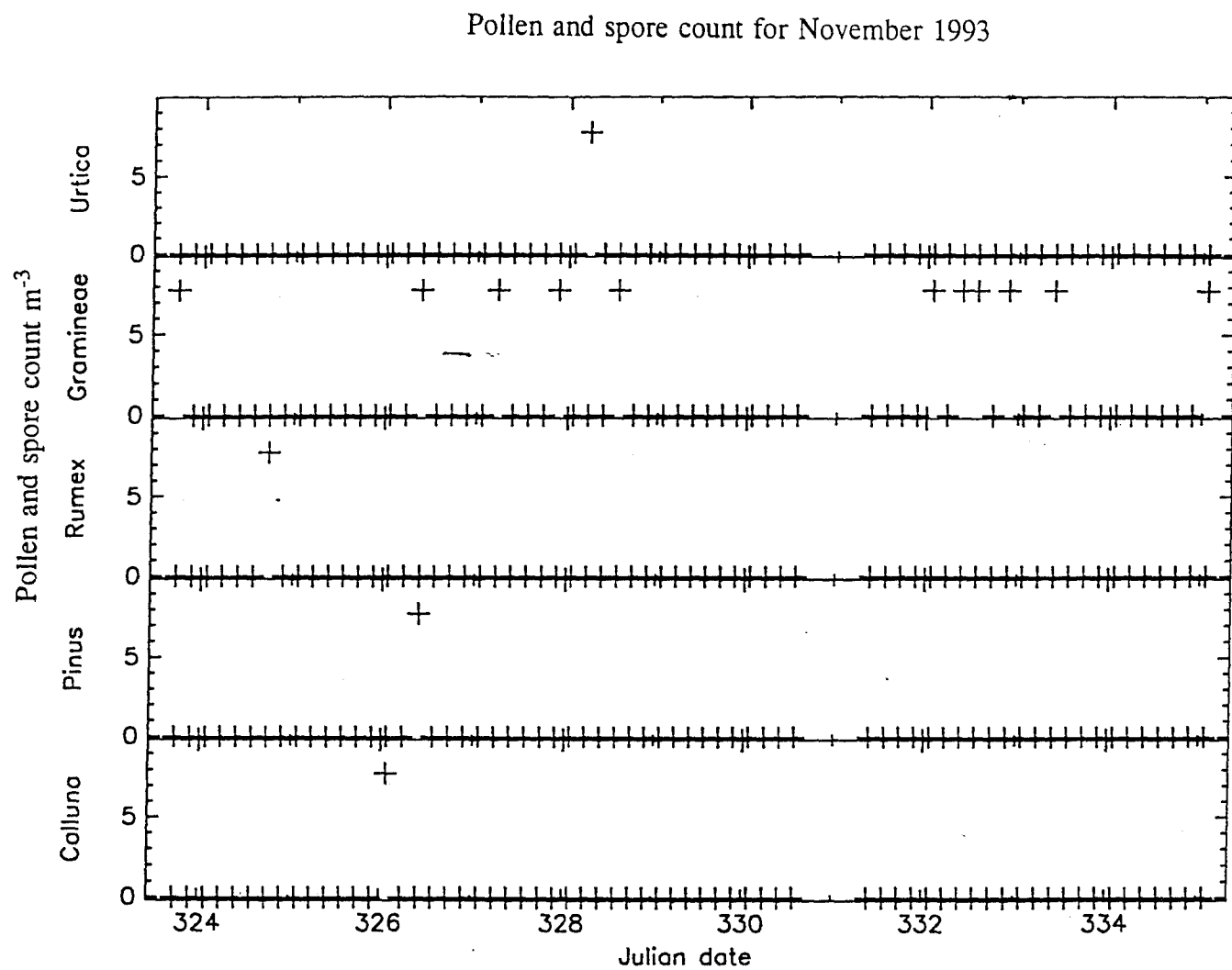




Figure 5(b)

Pollen and spore count for November 1993

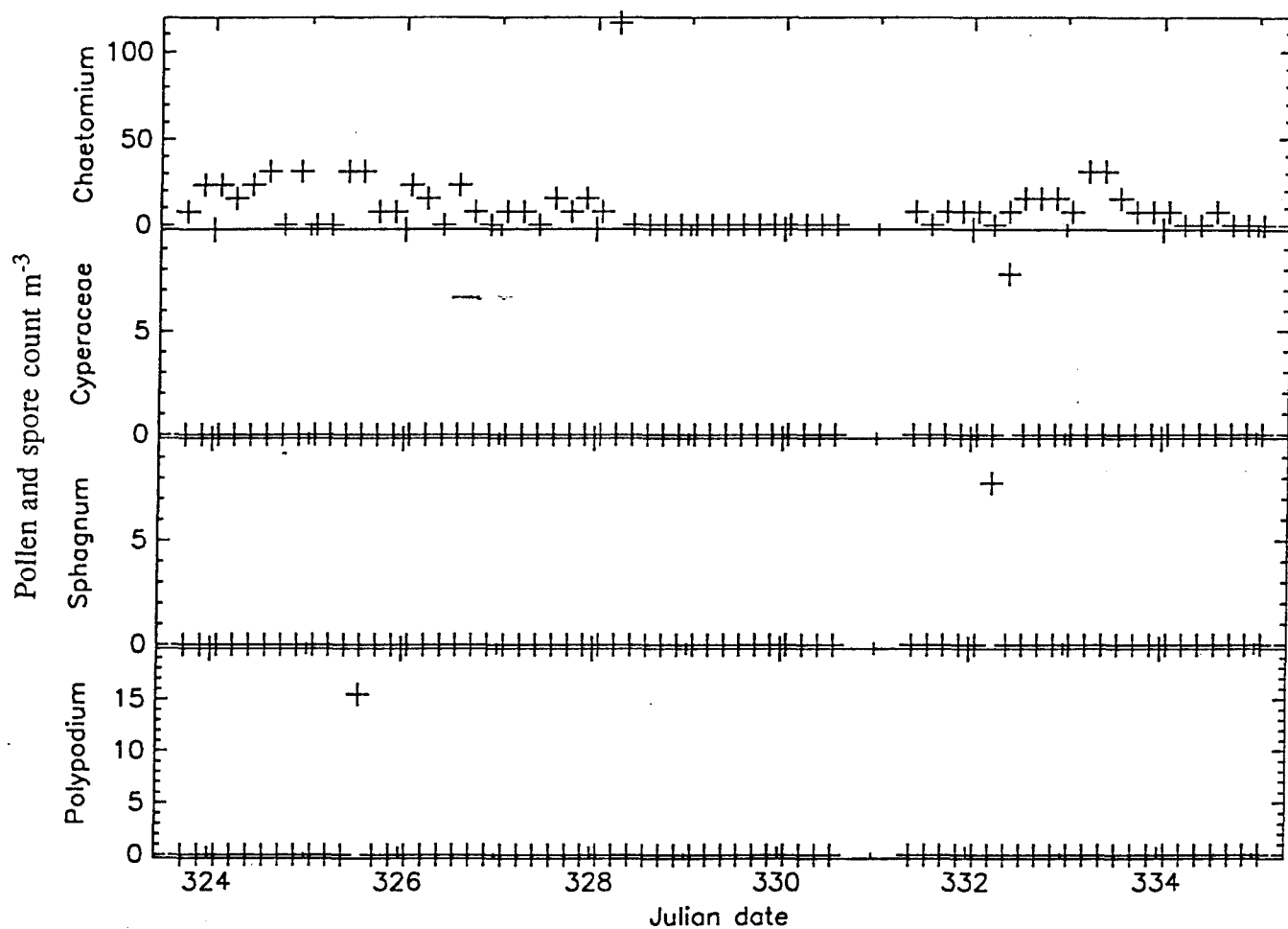


Figure 6

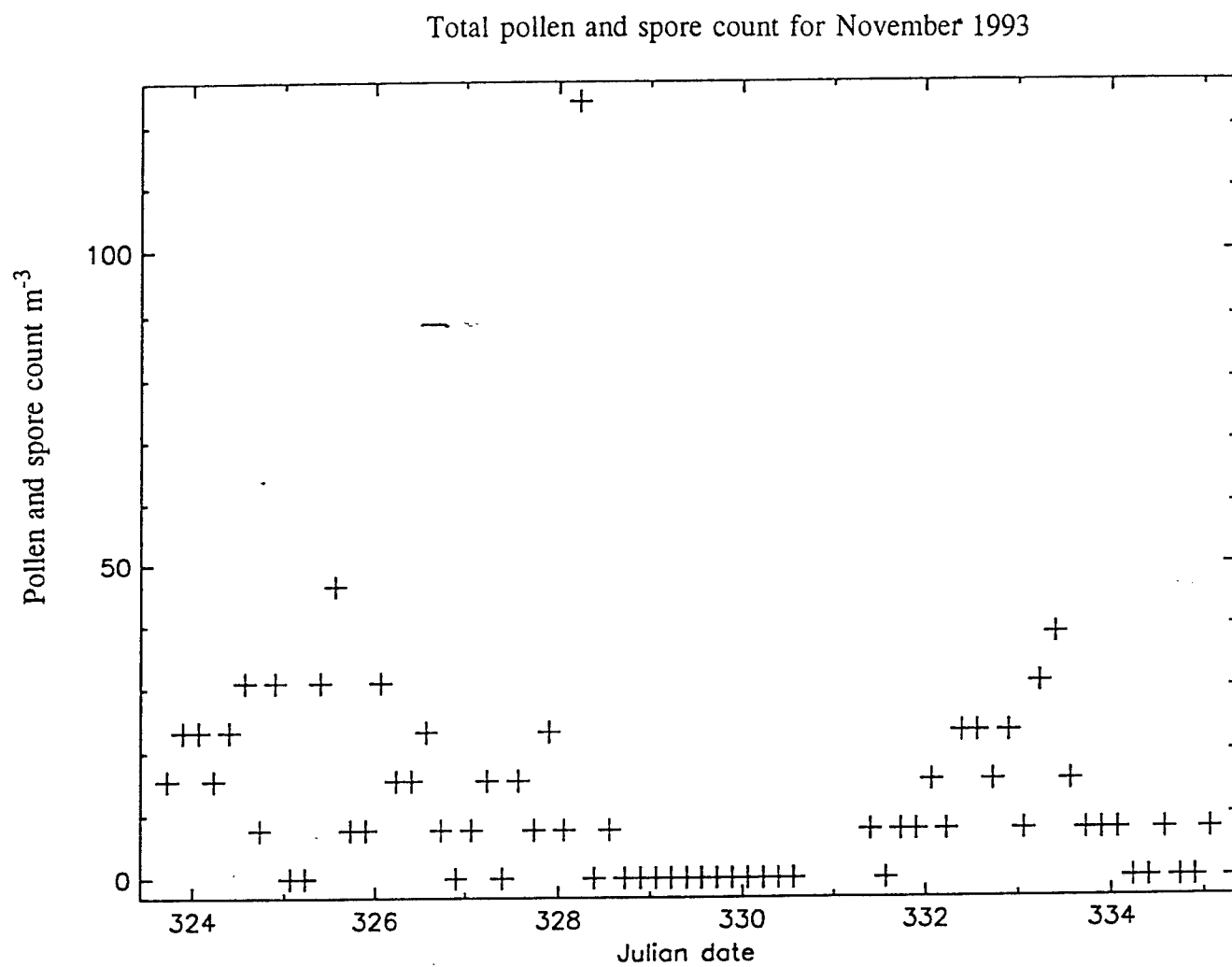


Figure 7

Pollen and spore count for December 1993

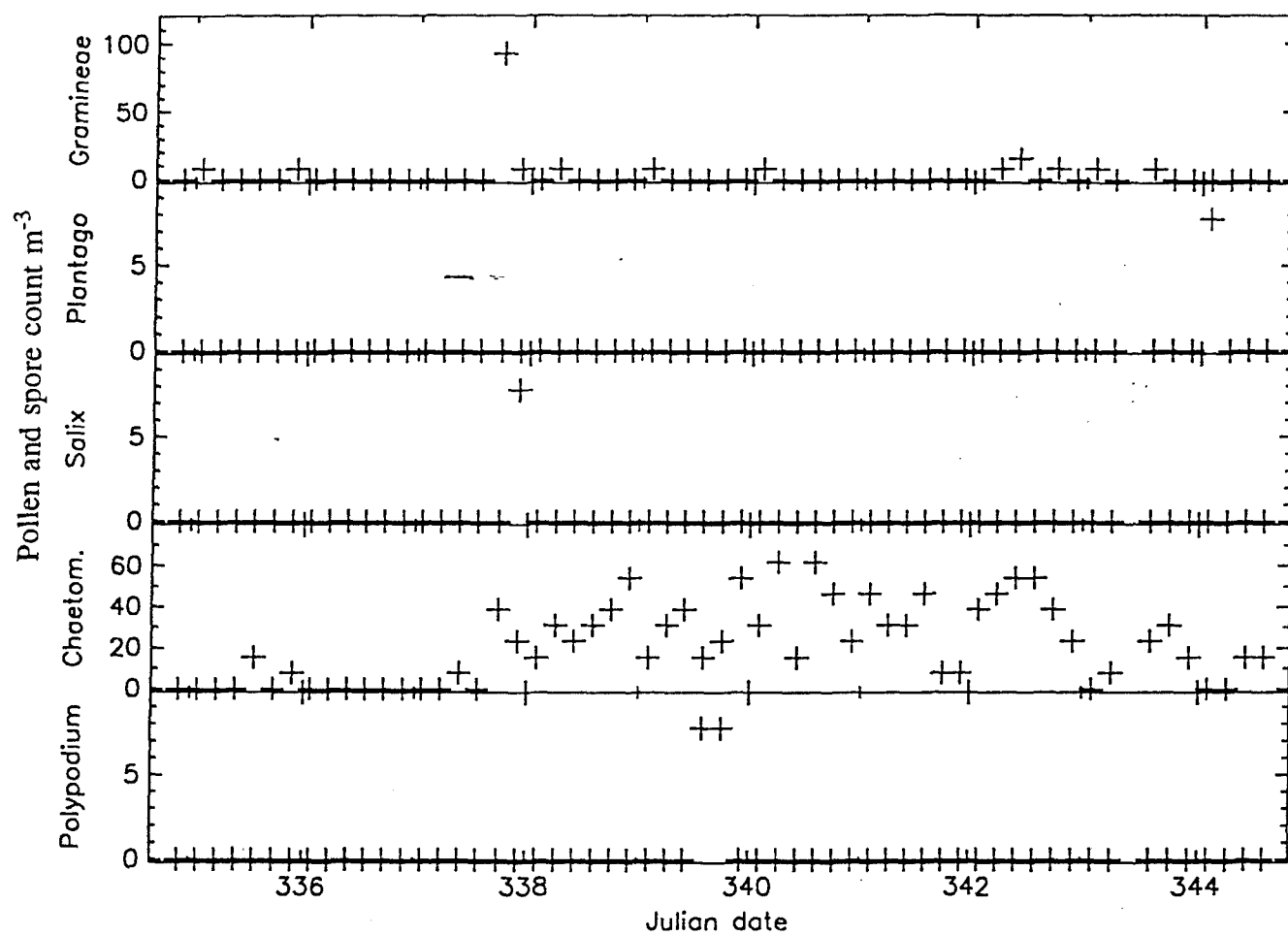


Figure 8

Total pollen and spore count for December 1993

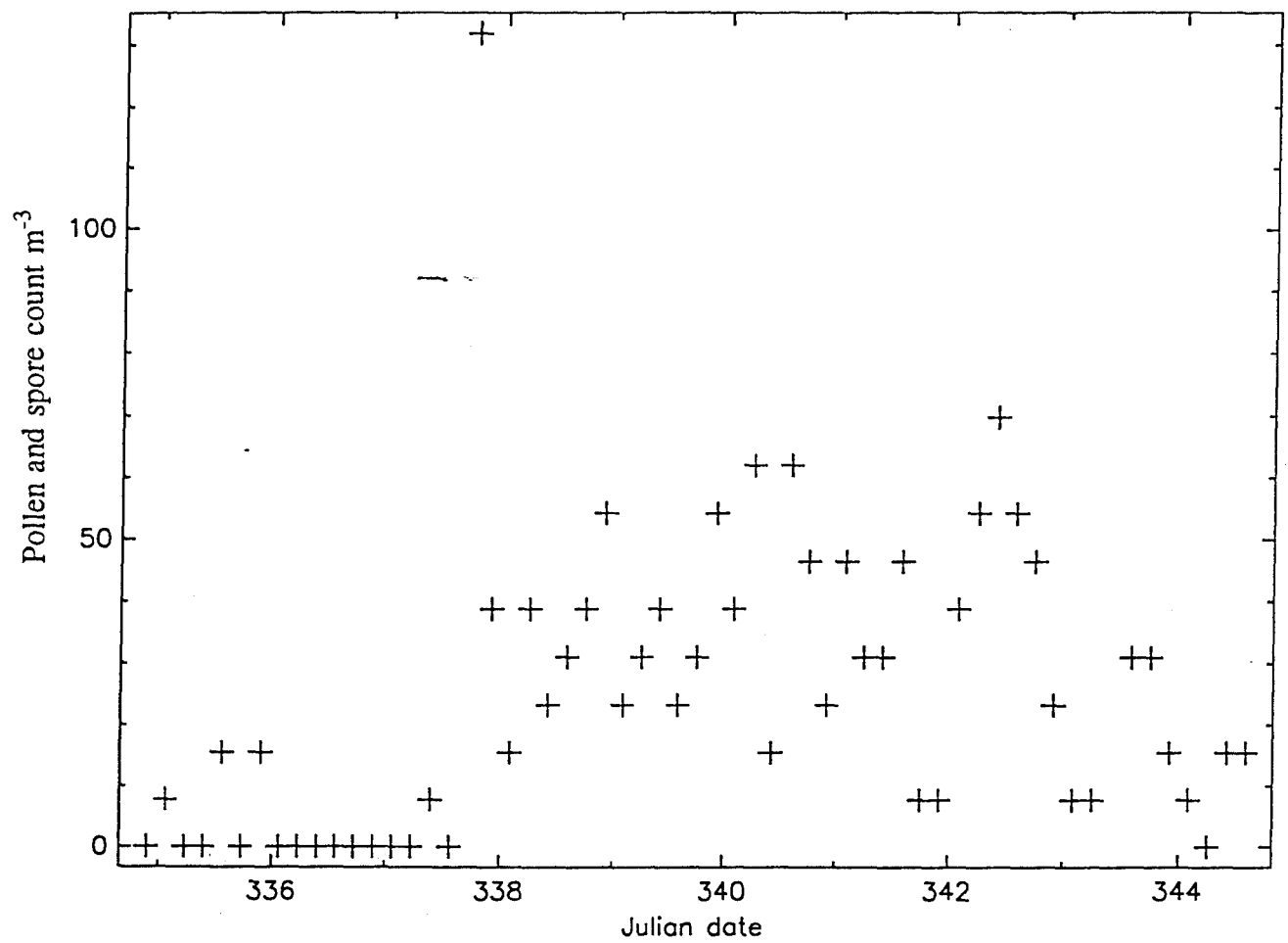


Figure 9

Pollen and spore count for January 1994

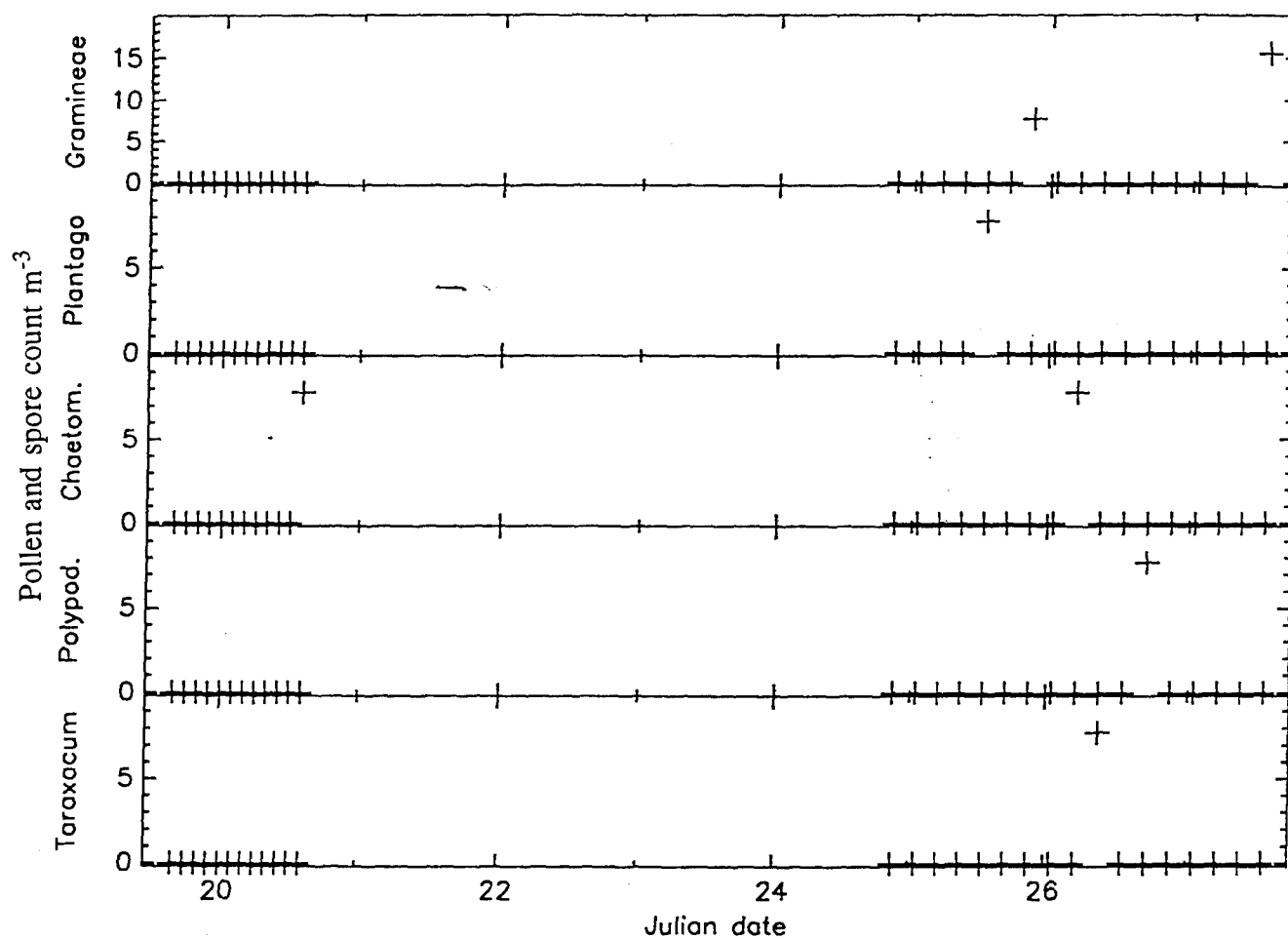


Figure 10

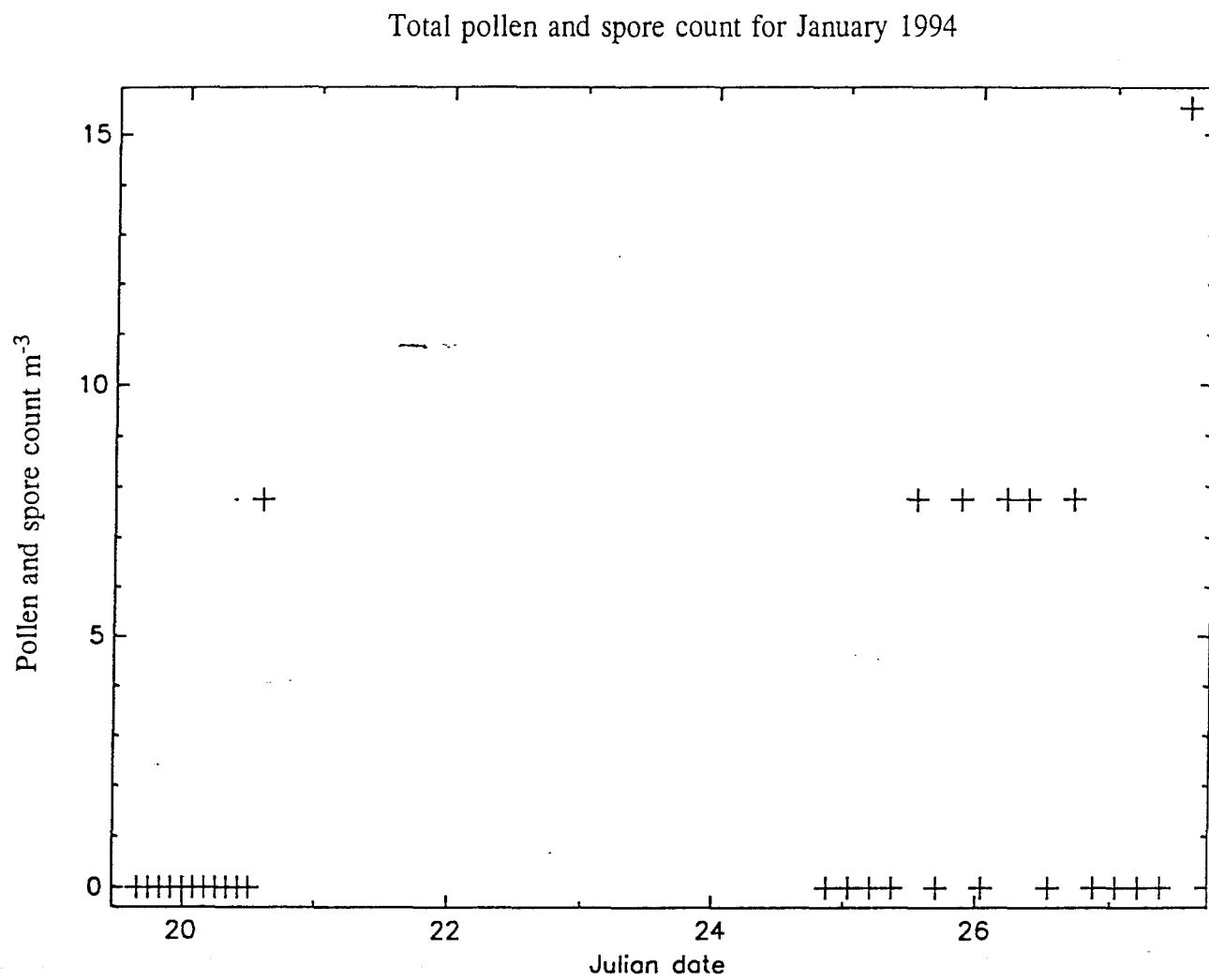


Figure 11(a)

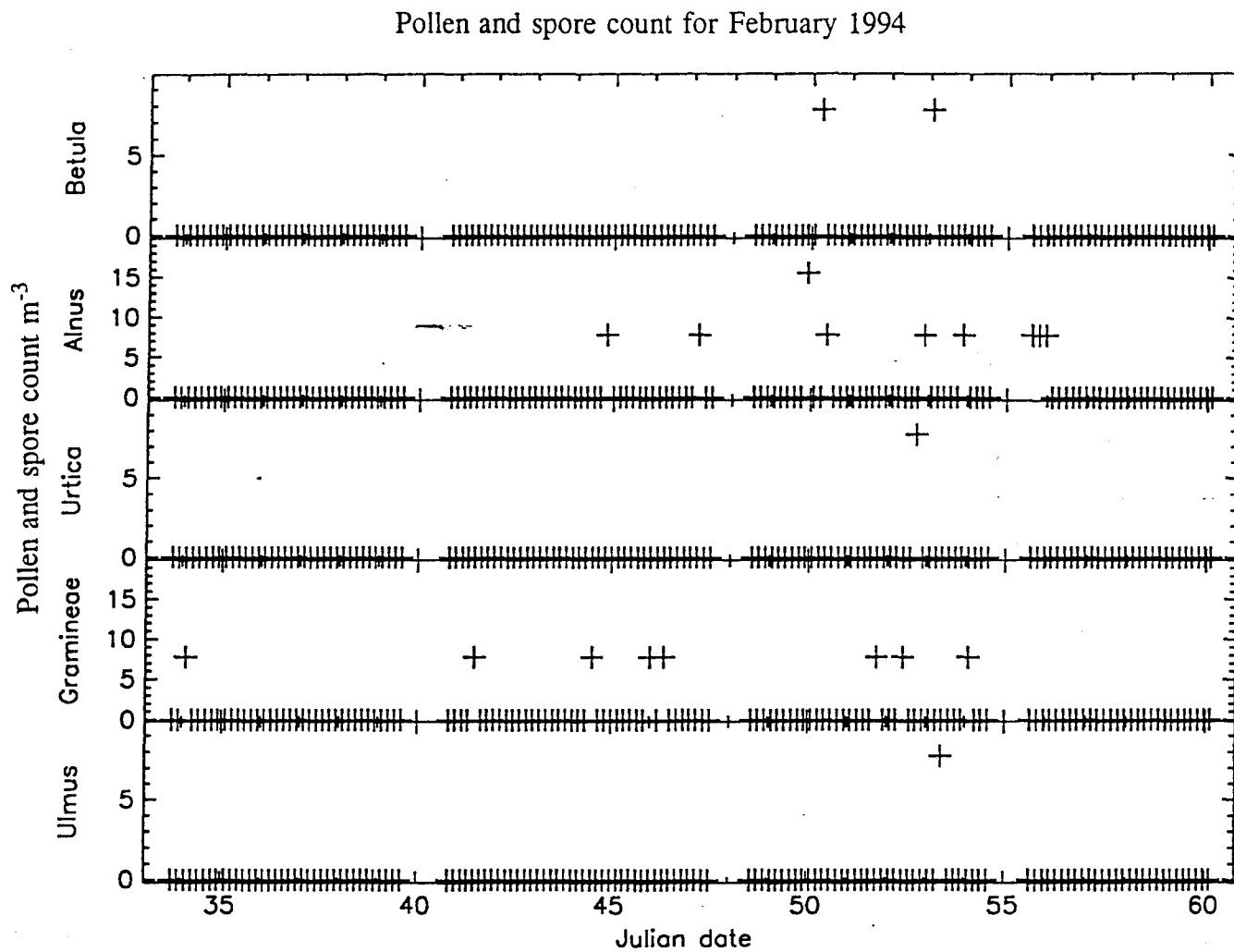


Figure 11(b)

Pollen and spore count for February 1994

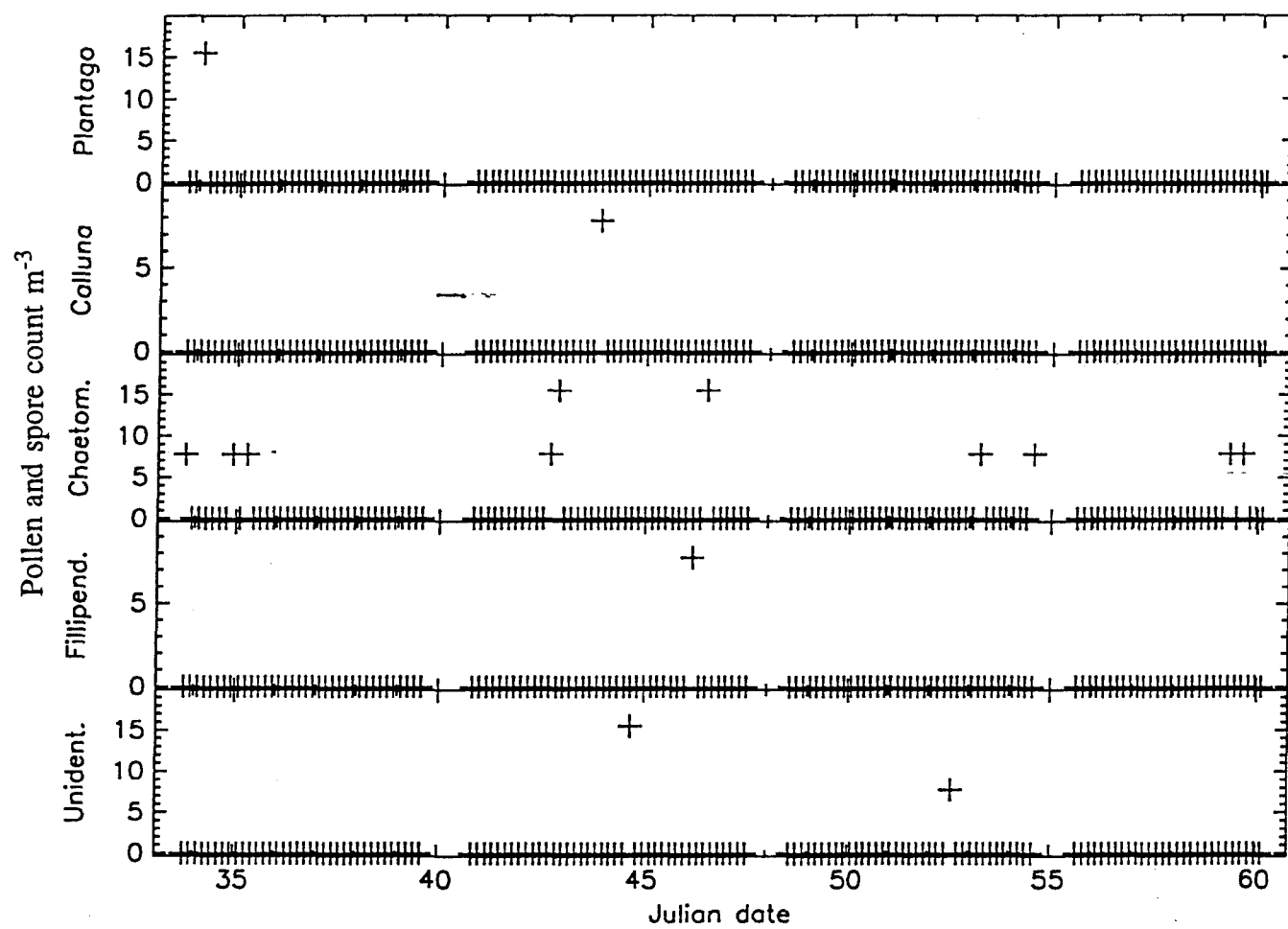




Figure 12

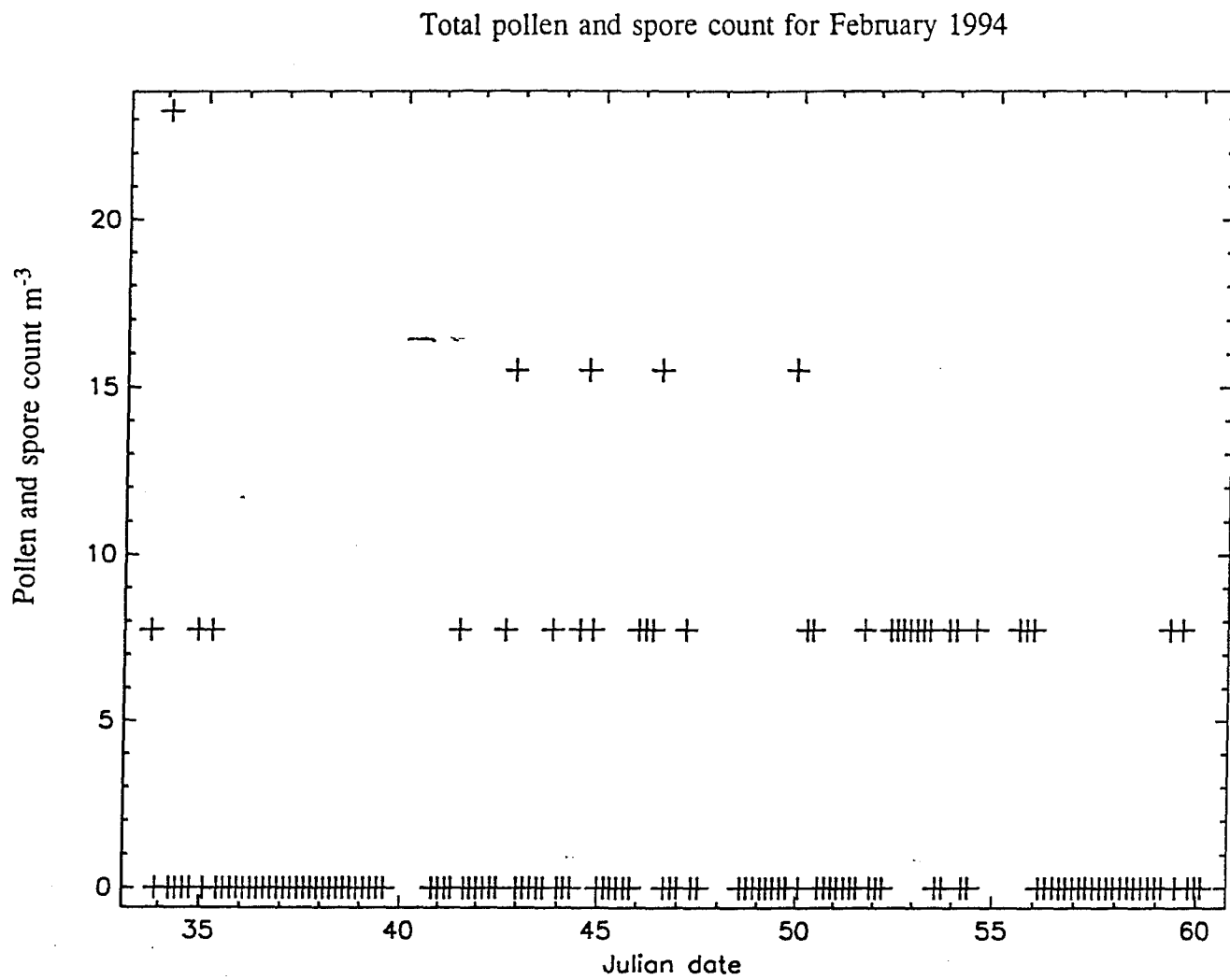


Figure 13

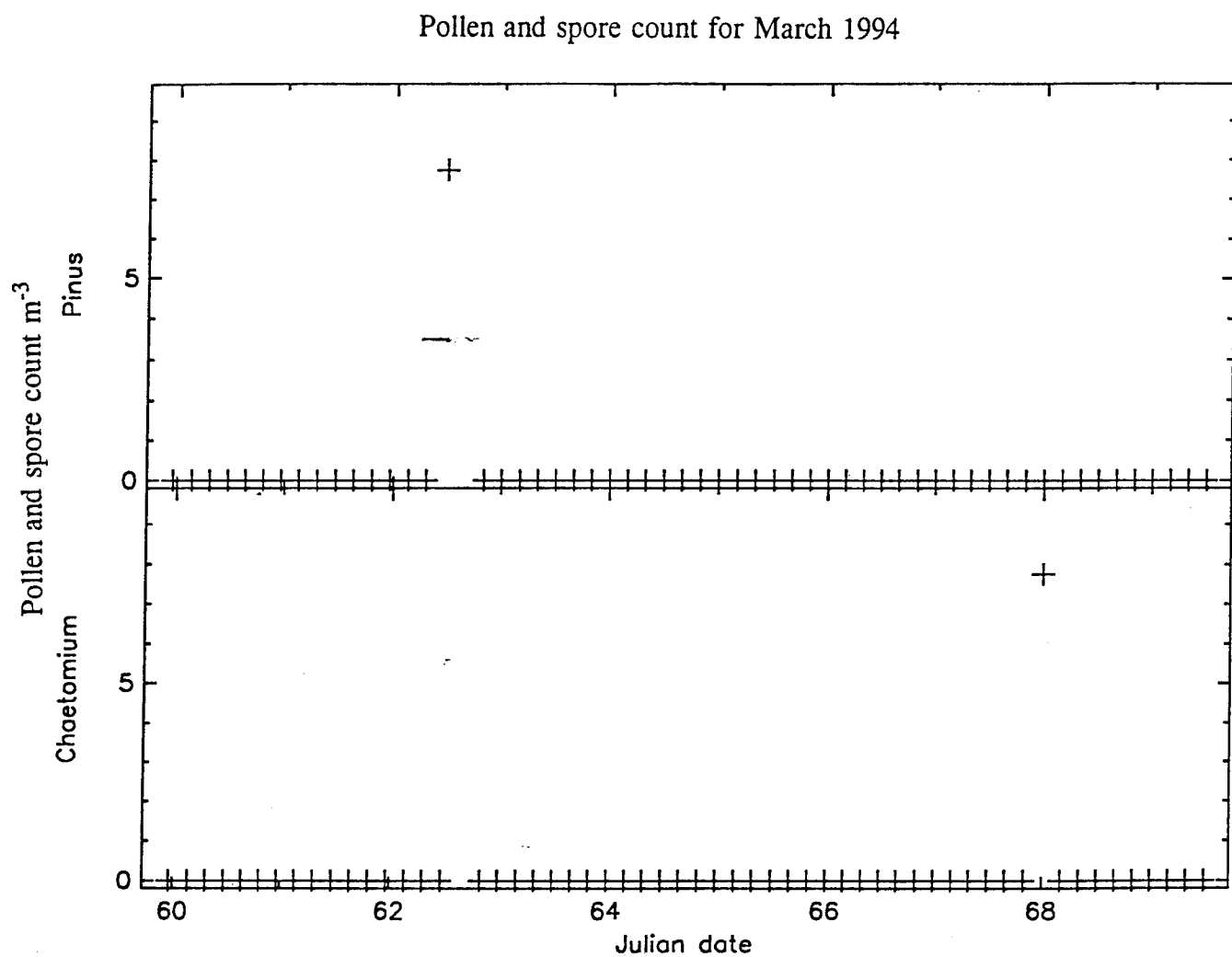


Figure 14

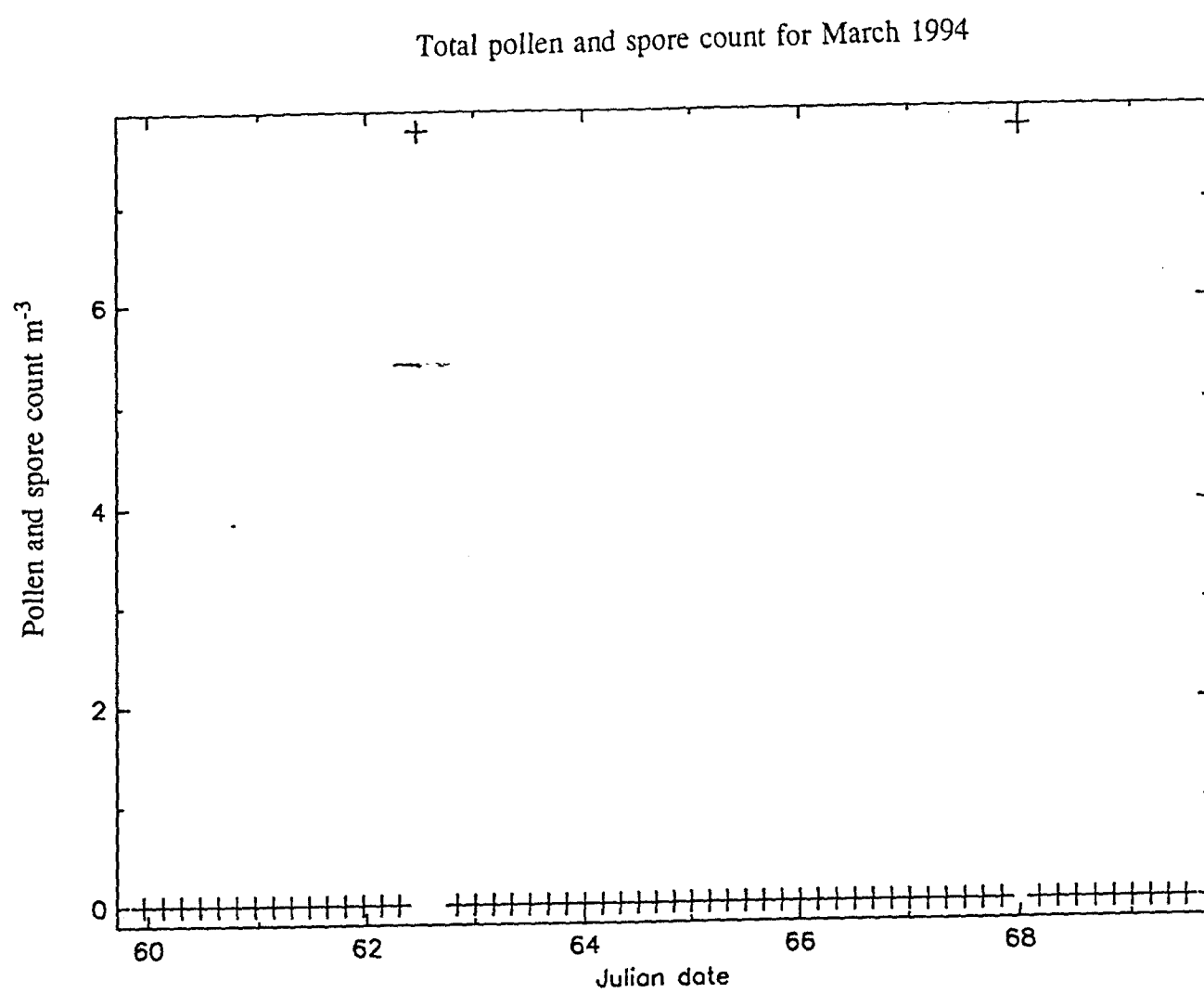


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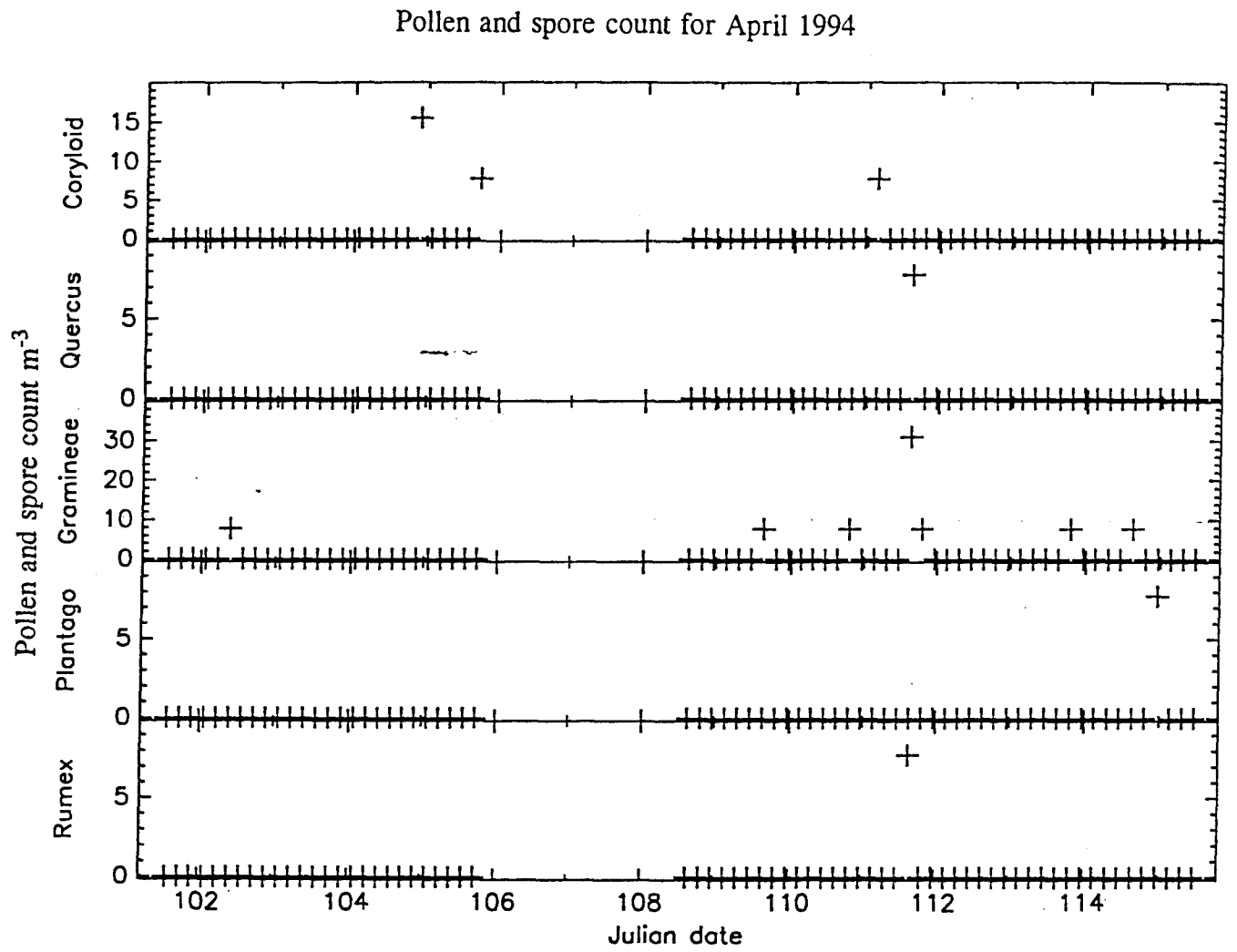


Figure 15(b)

Pollen and spore count for April 1994

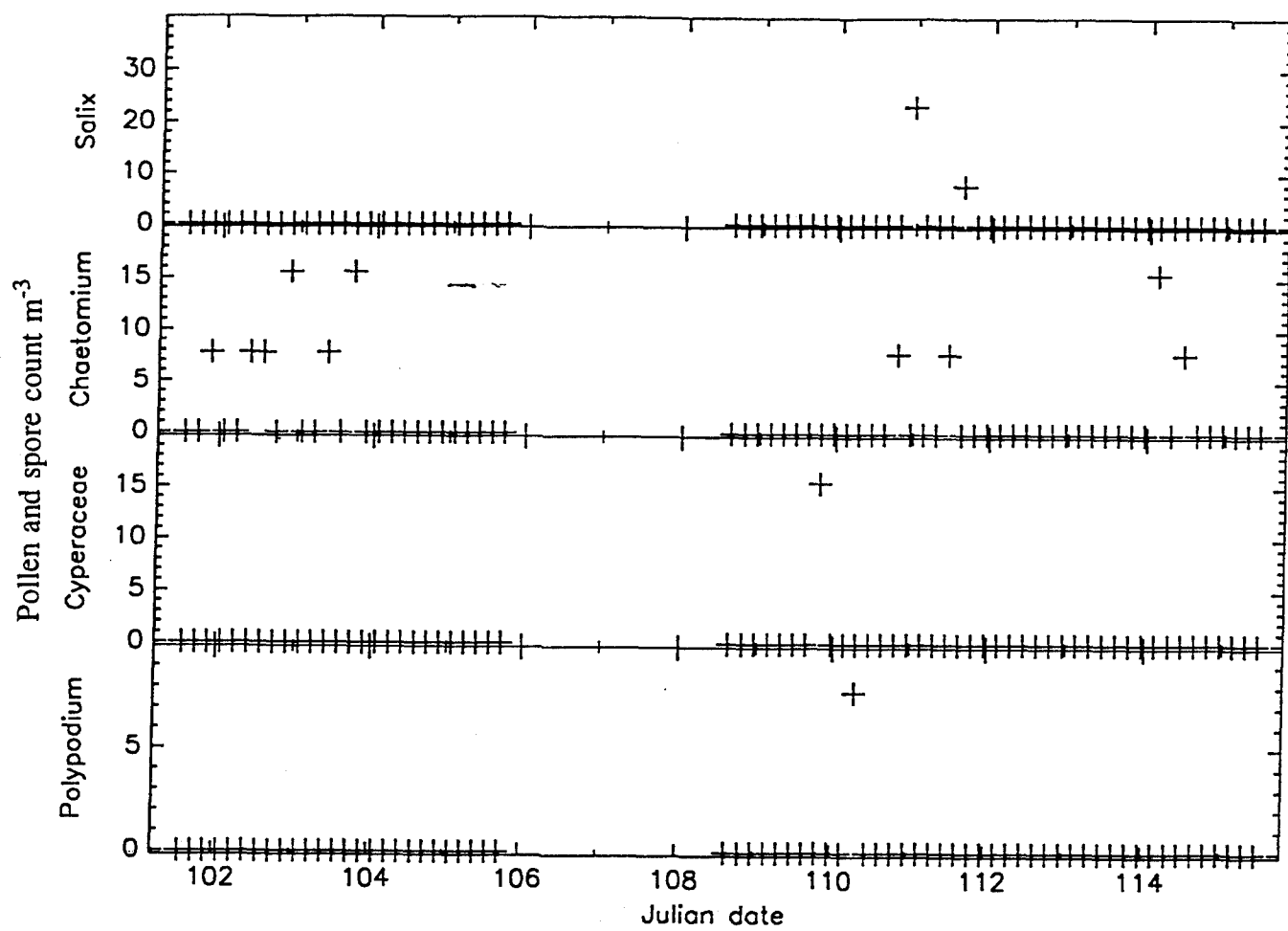


Figure 16

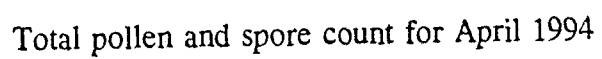


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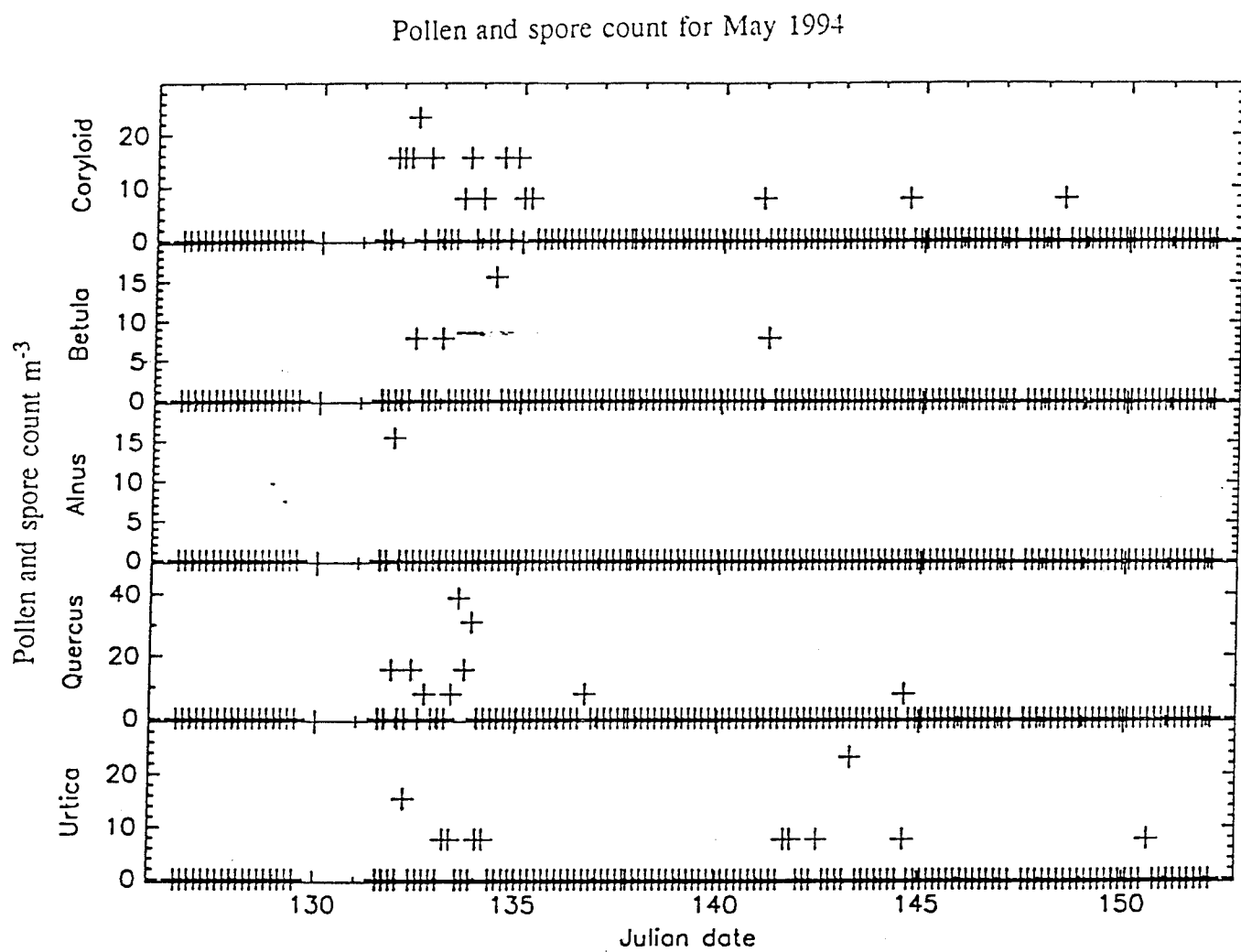


Figure 17(b)

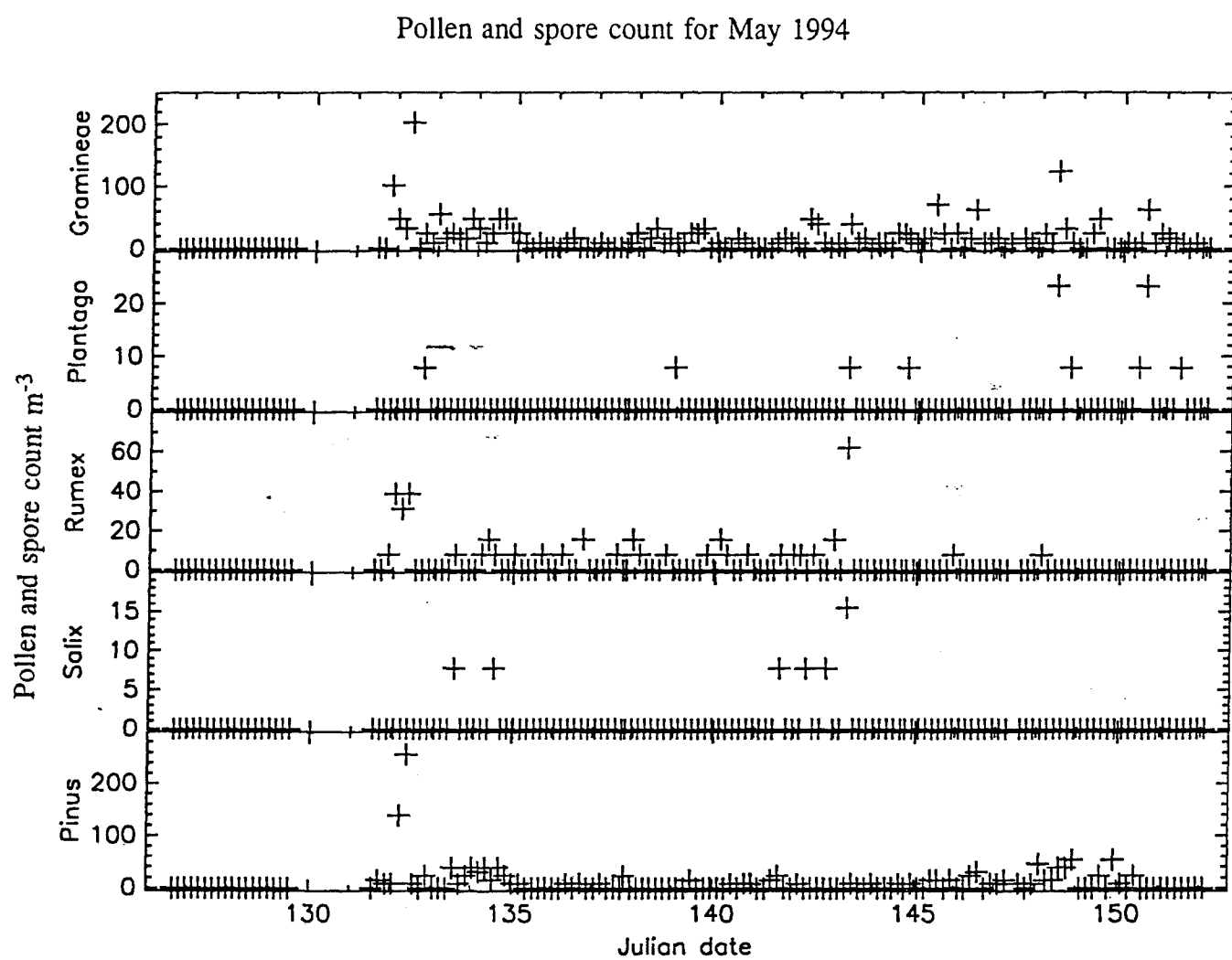




Figure 17(c)

Pollen and spore count for May 1994

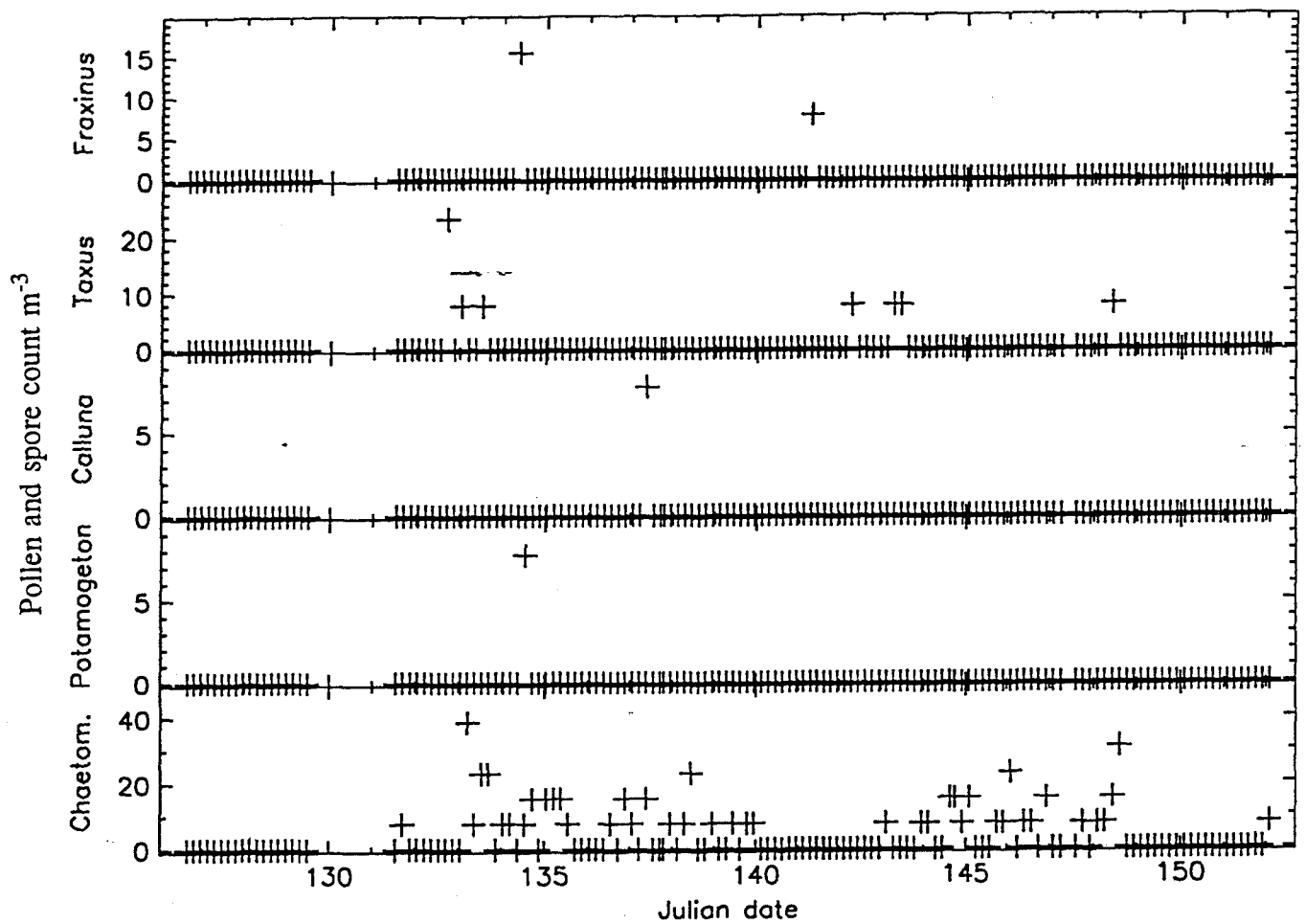


Figure 17(d)

Pollen and spore count for May 1994

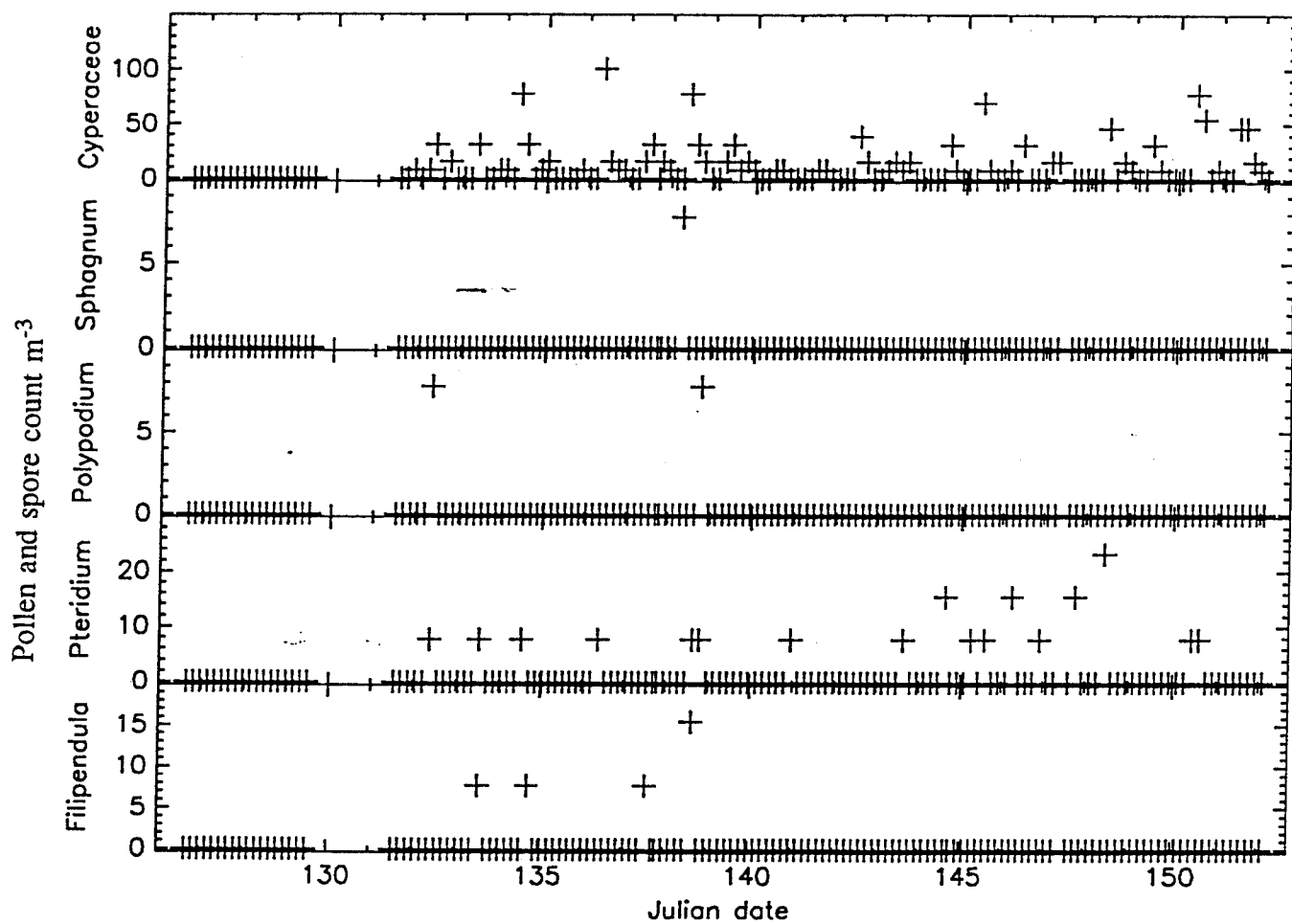


Figure 17(e)

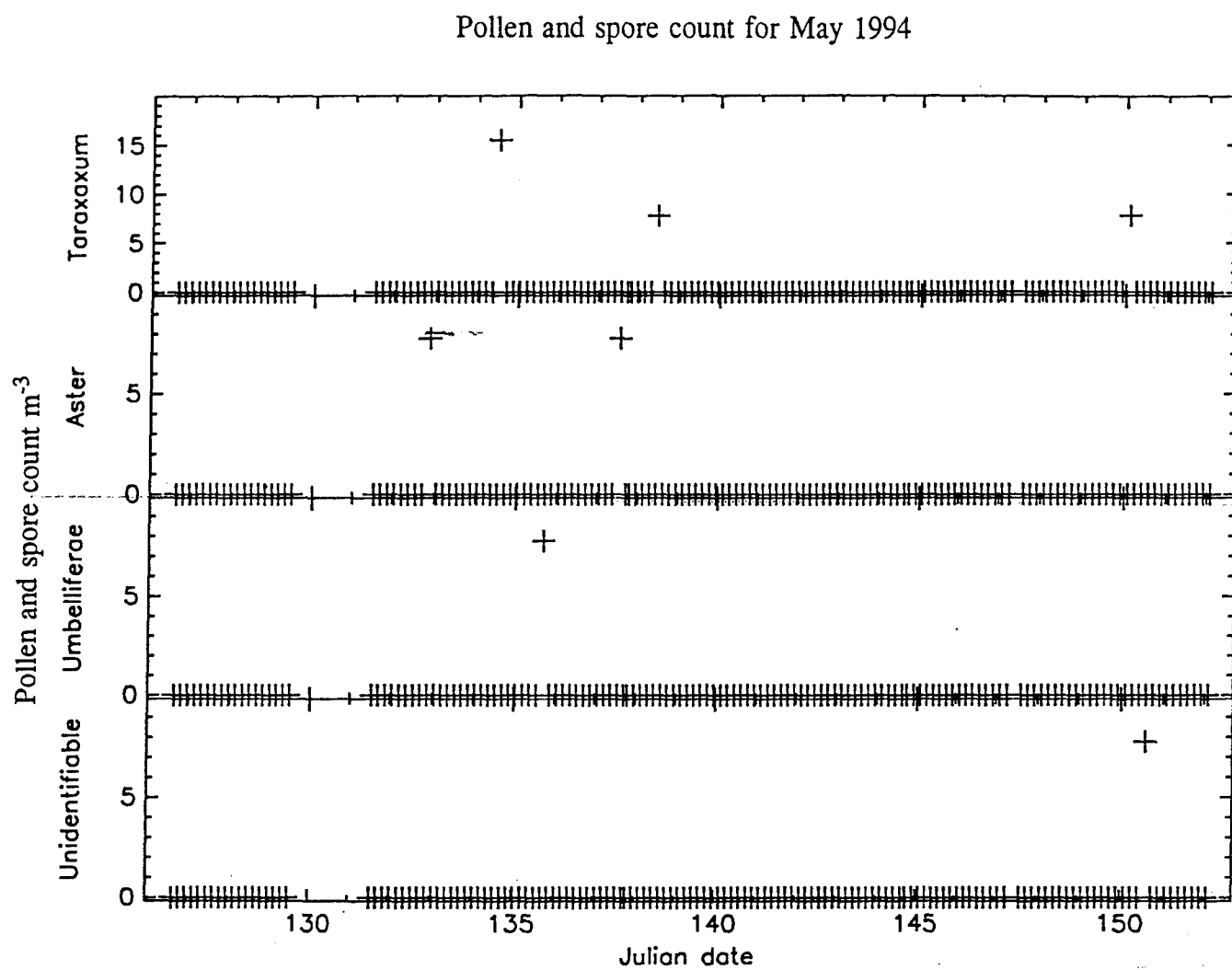


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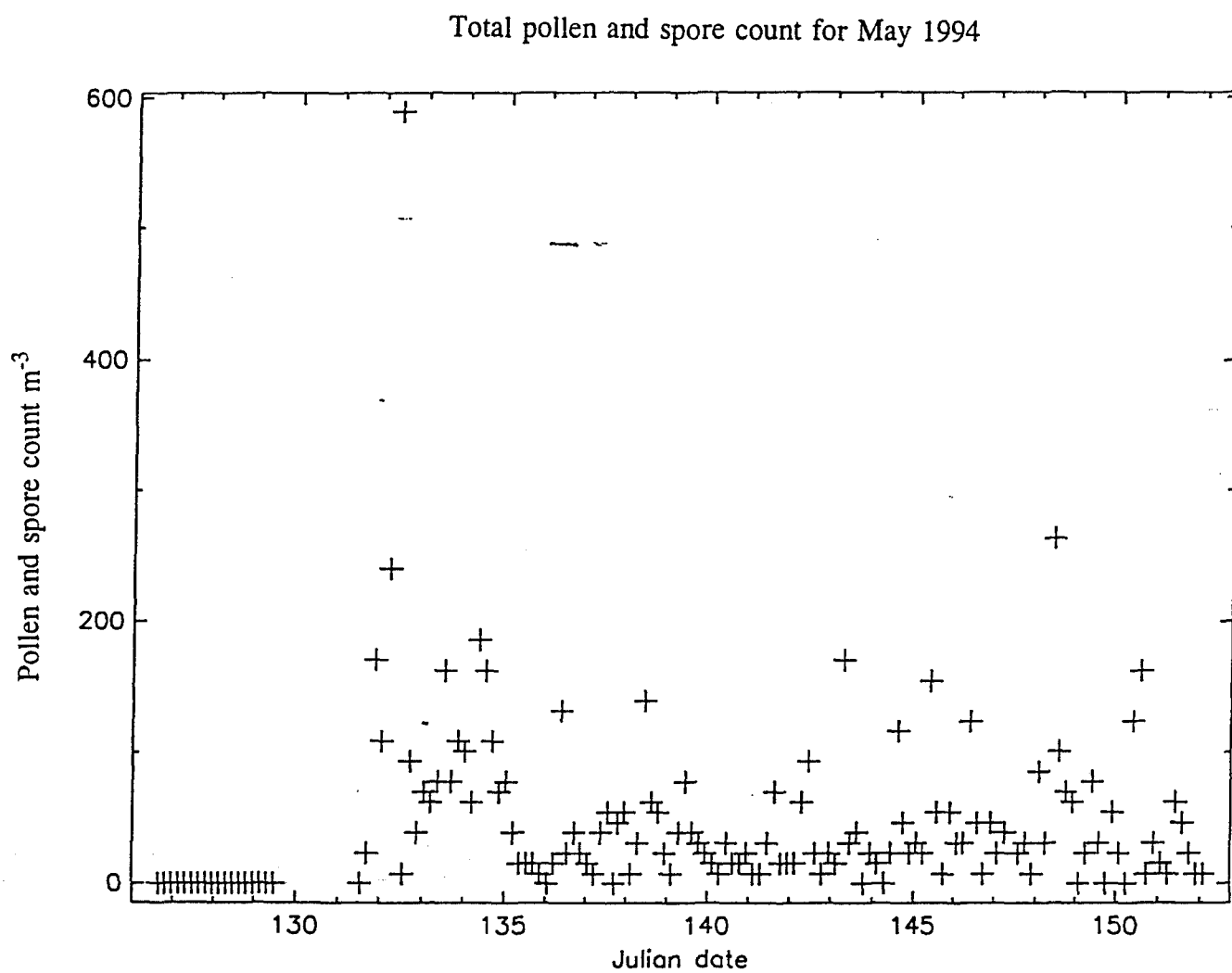


Figure 19(a)

Pollen and spore count for June 1994

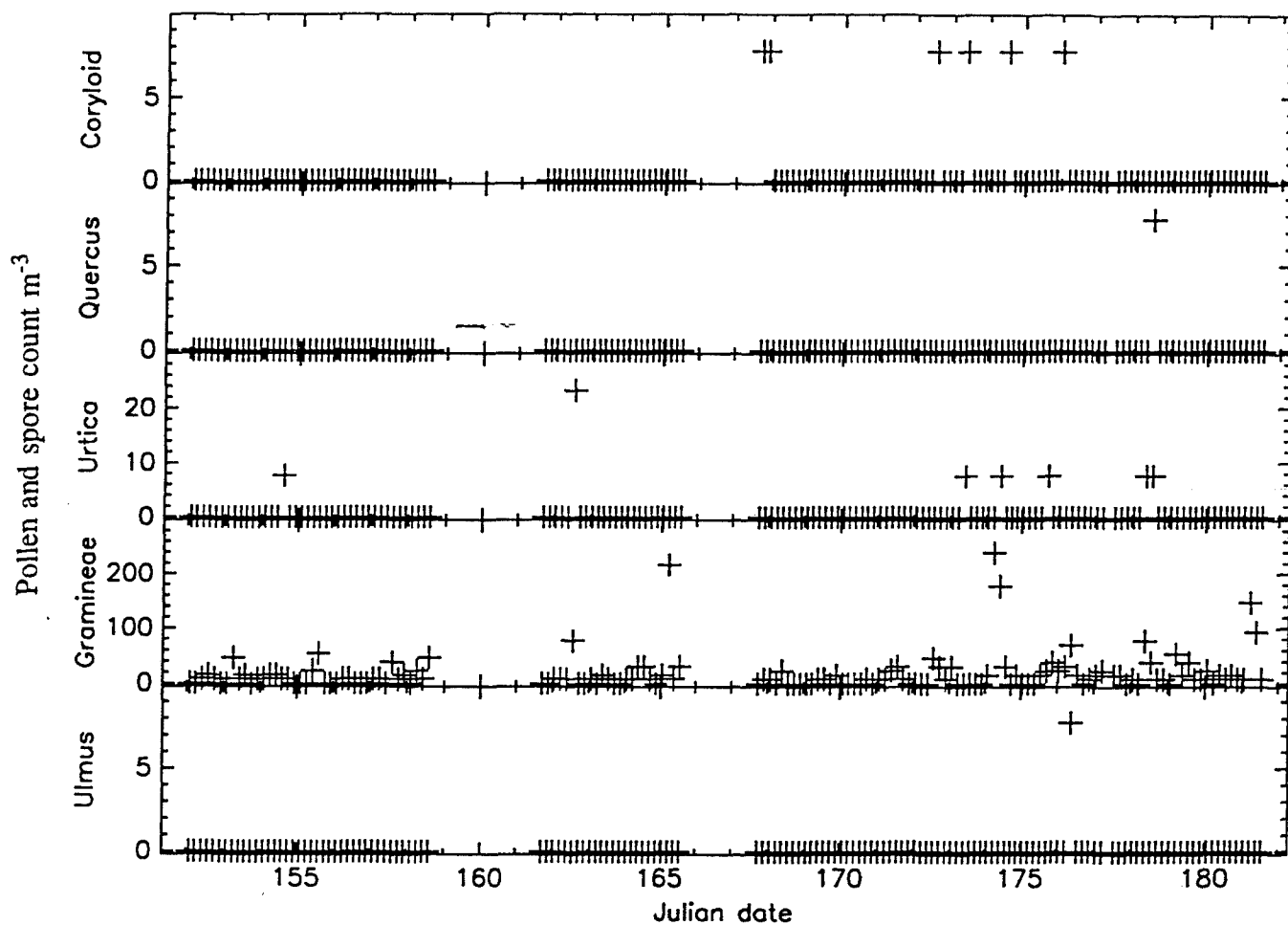


Figure 19(b)

Pollen and spore count for June 1994

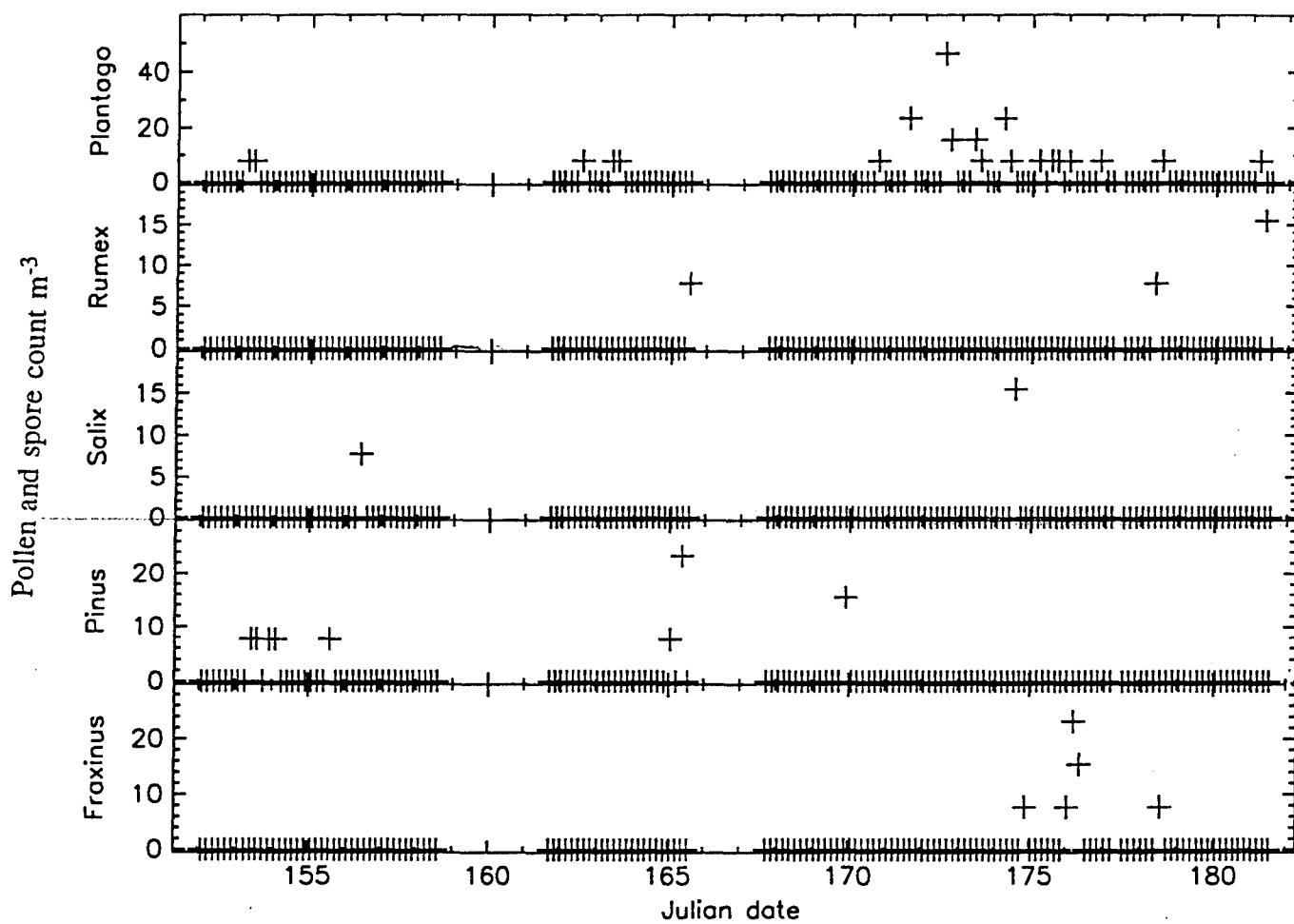


Figure 19(c)

Pollen and spore count for June 1994

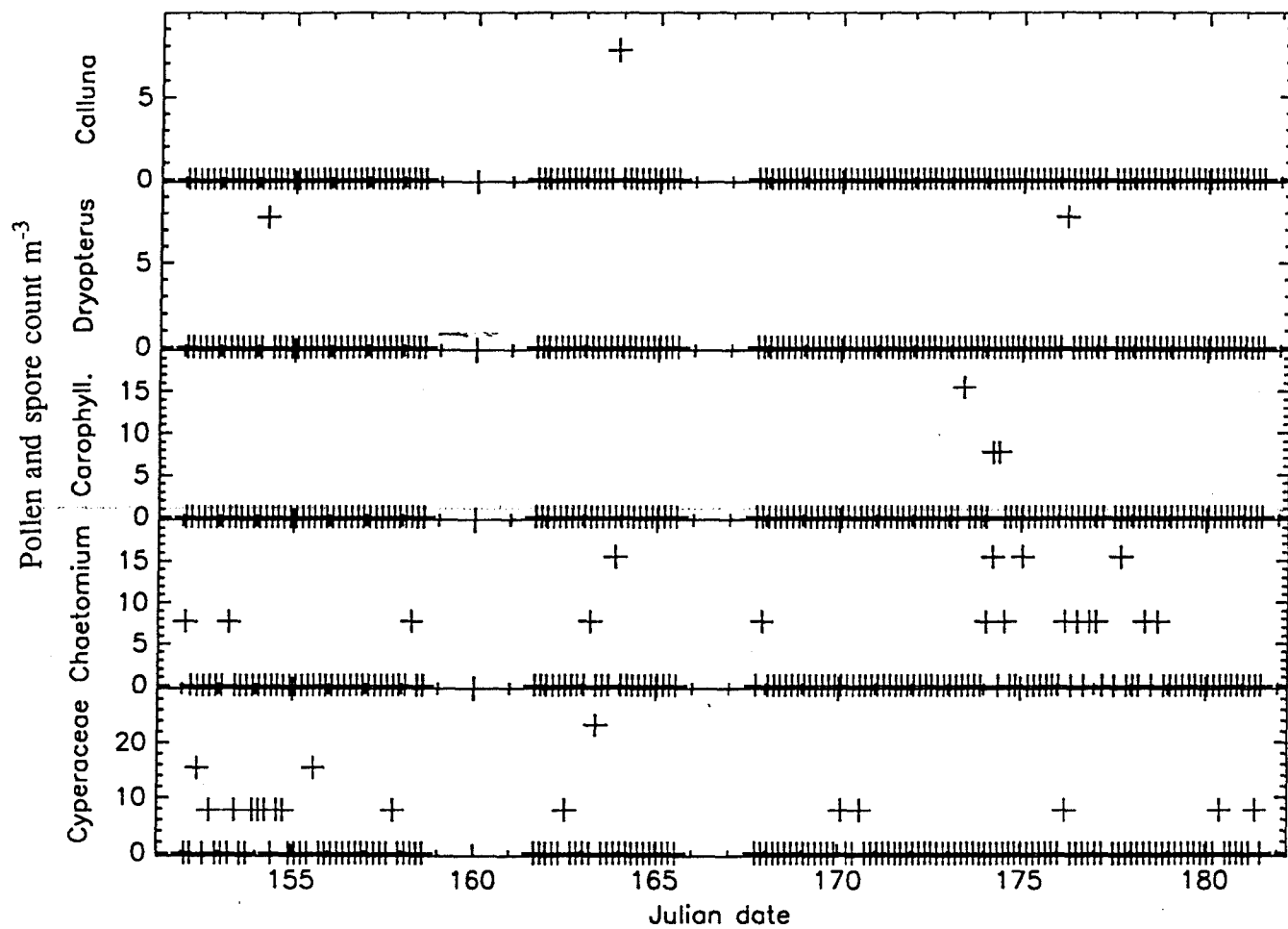


Figure 19(d)

Pollen and spore count for June 1994

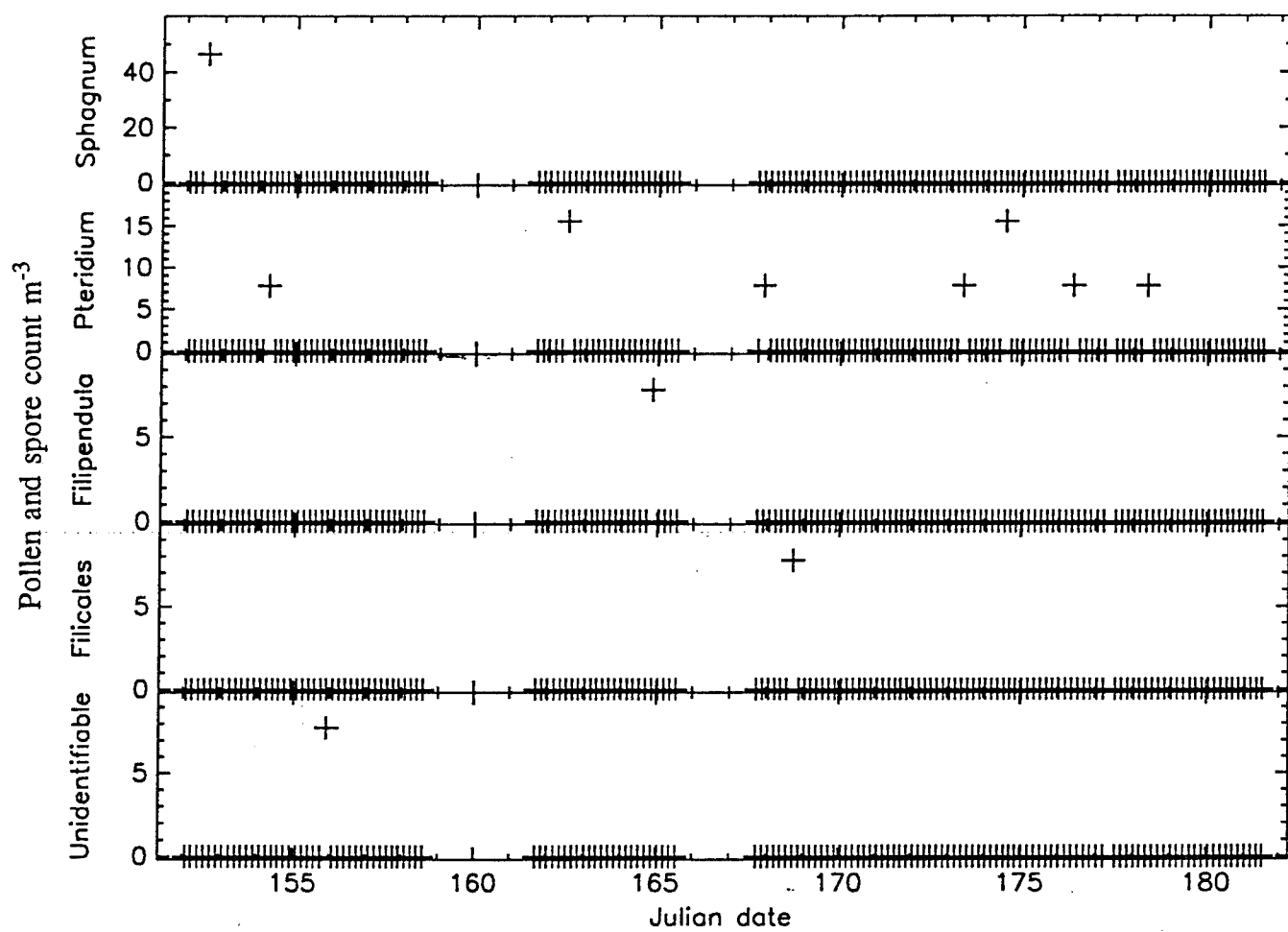




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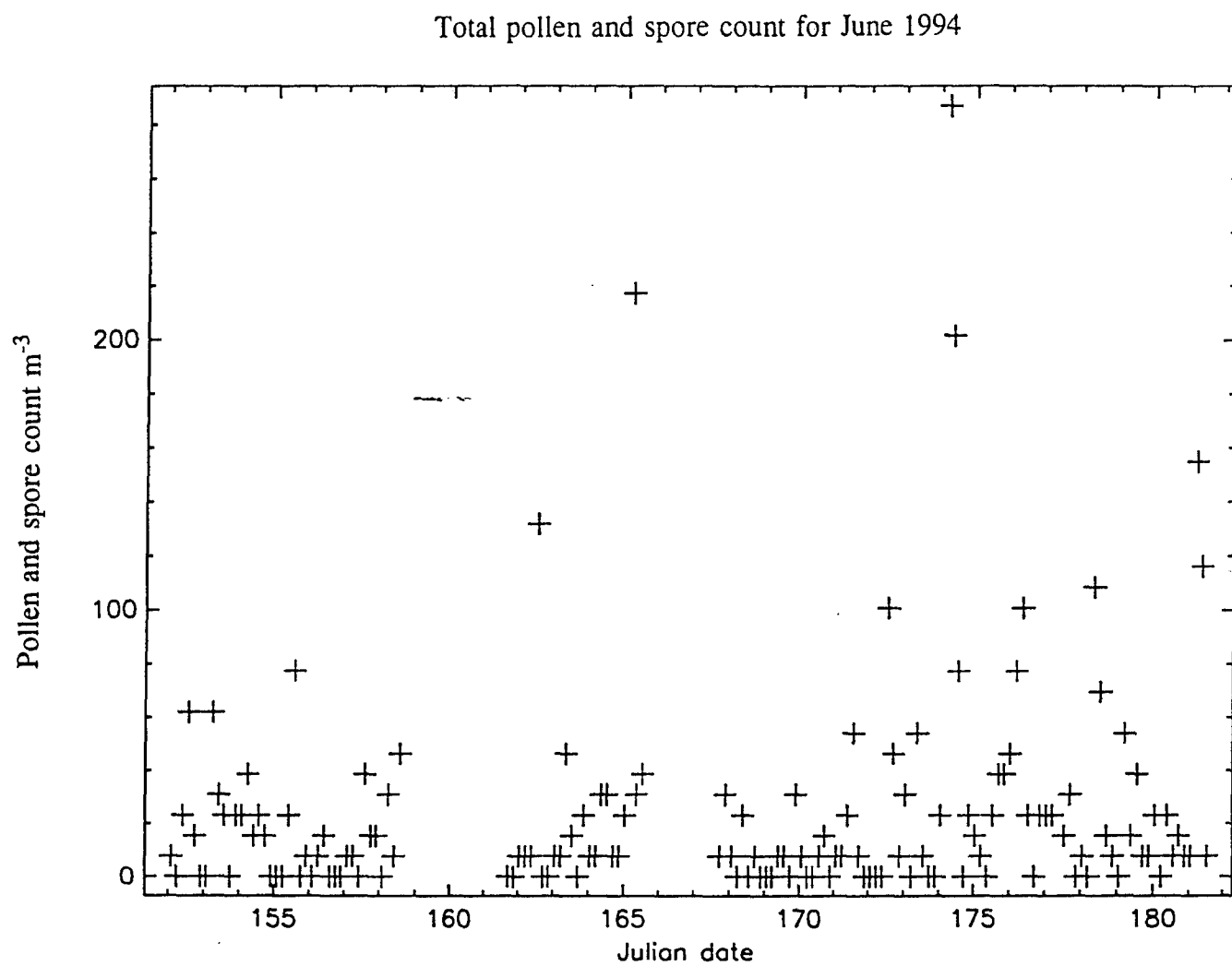


Figure 21

Total pollen and spore count for March to June 1993

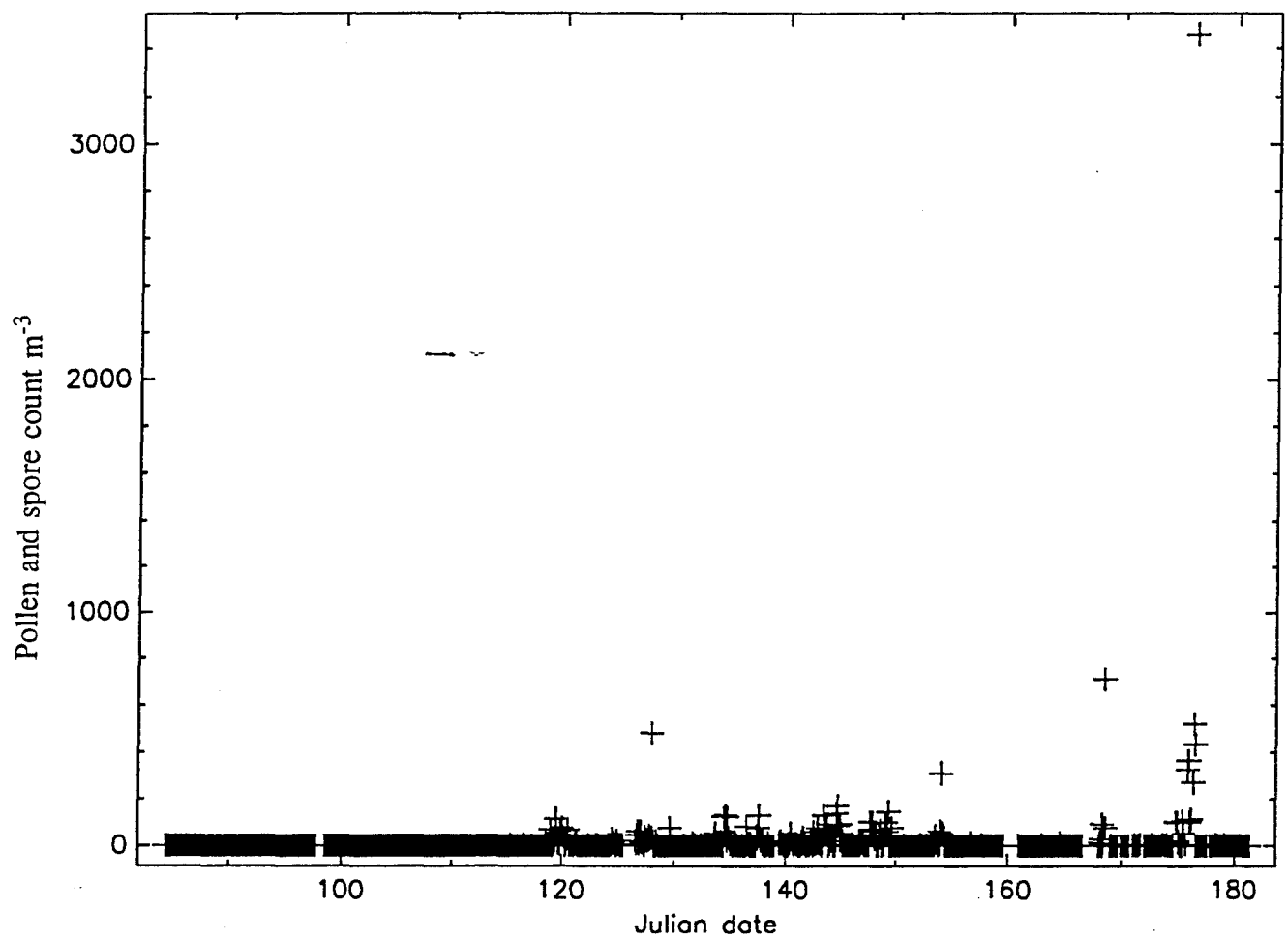


Figure 21(a)

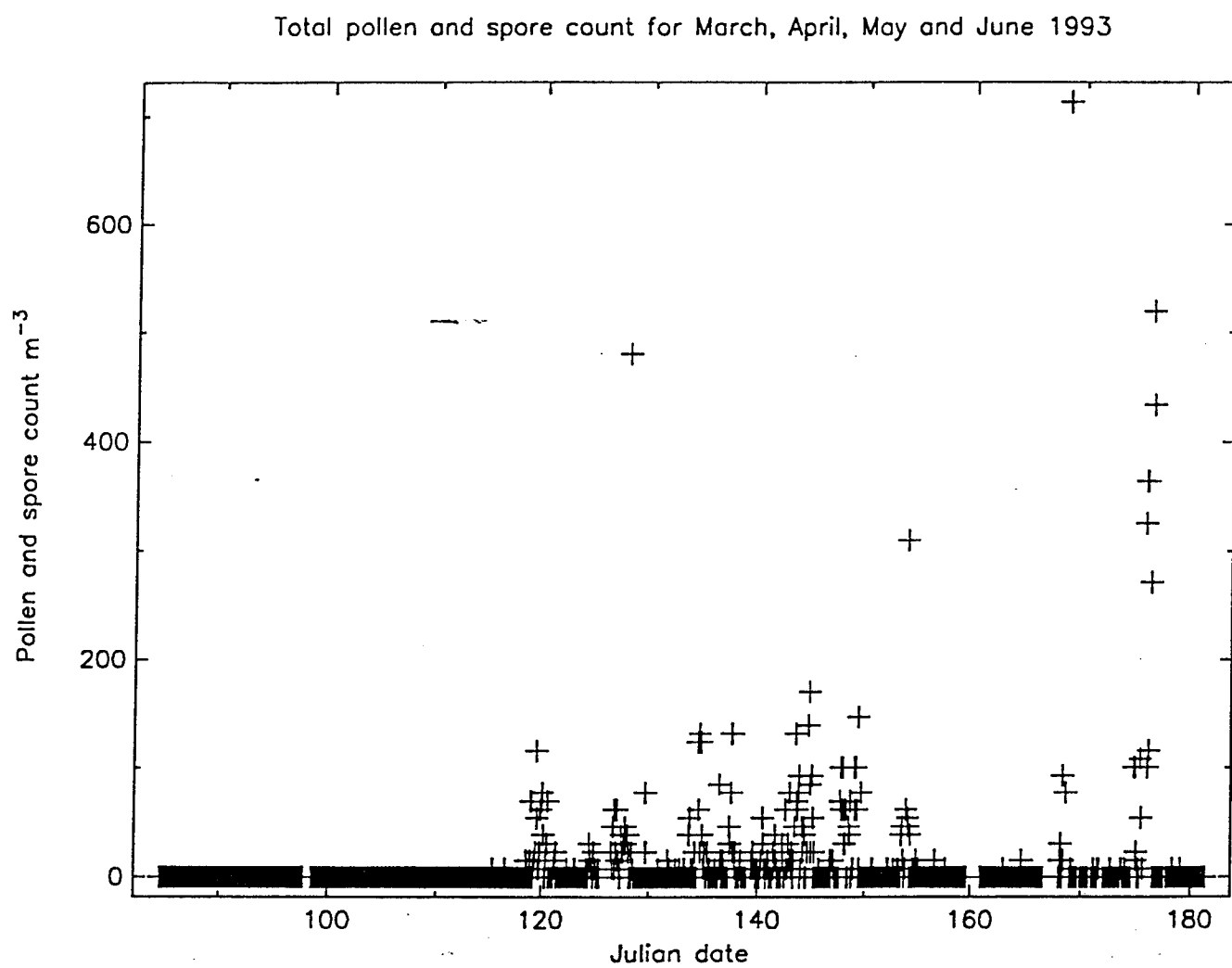


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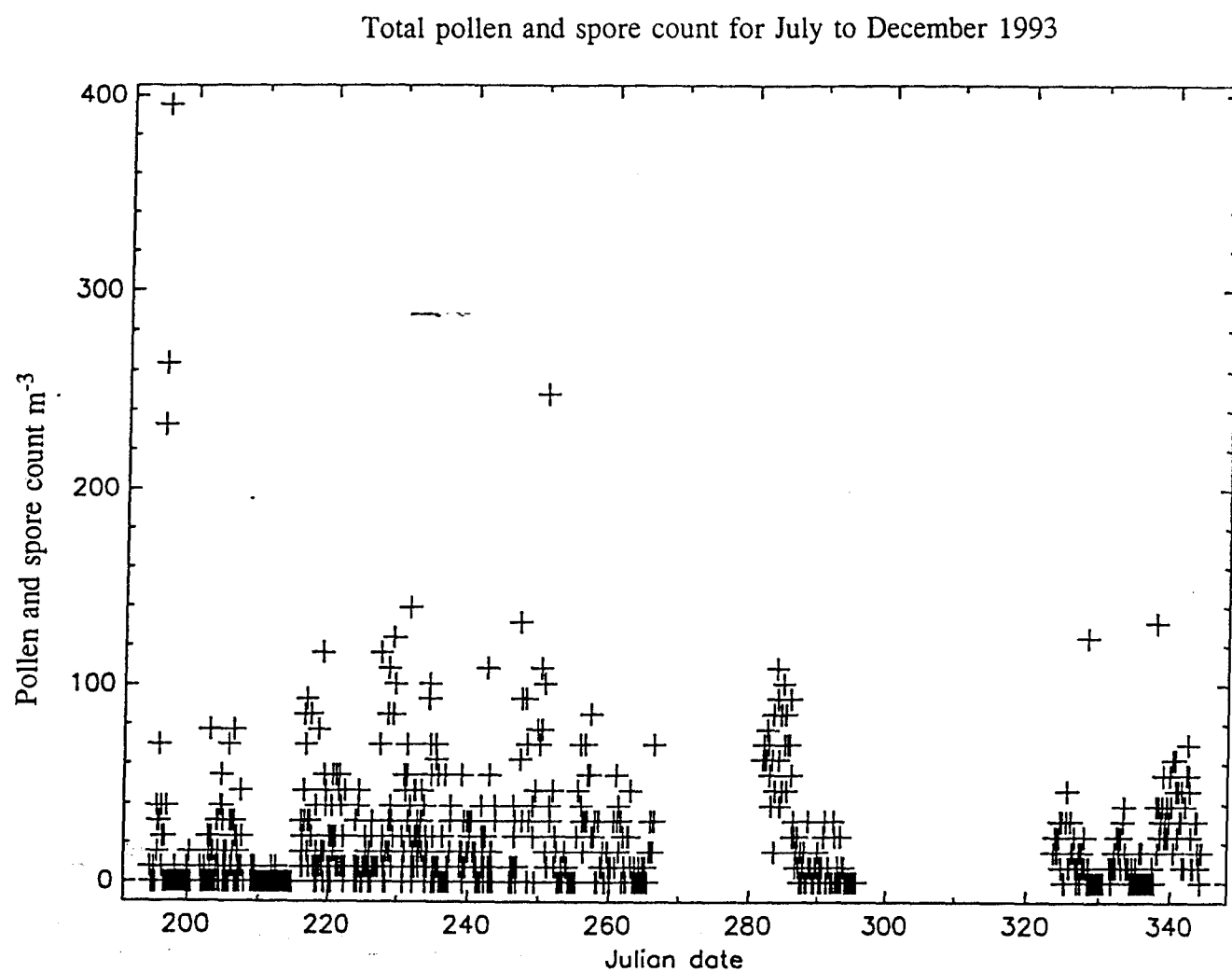


Figure 23

Total pollen and spore count for January to June 1994

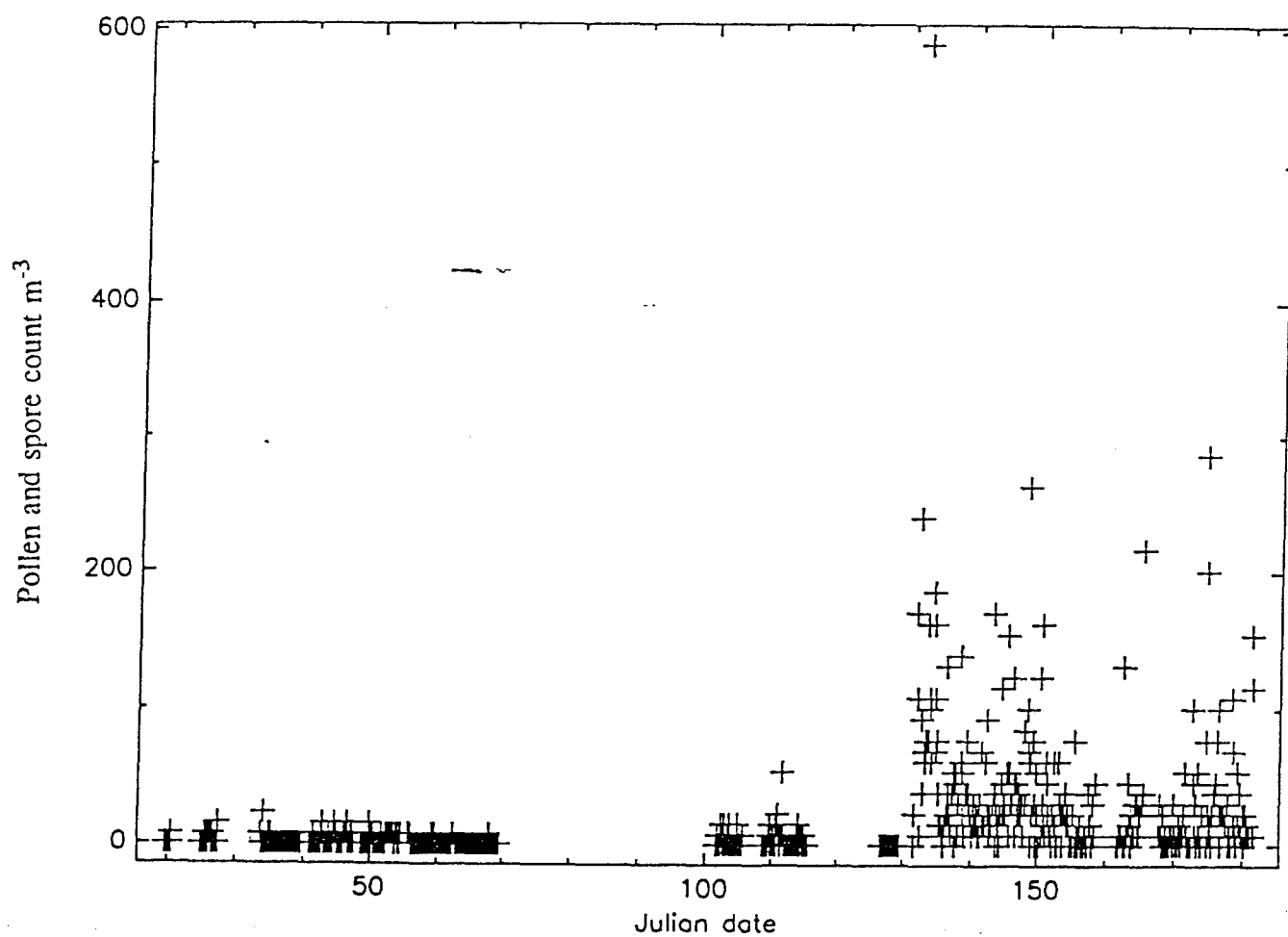


Figure 24(a)

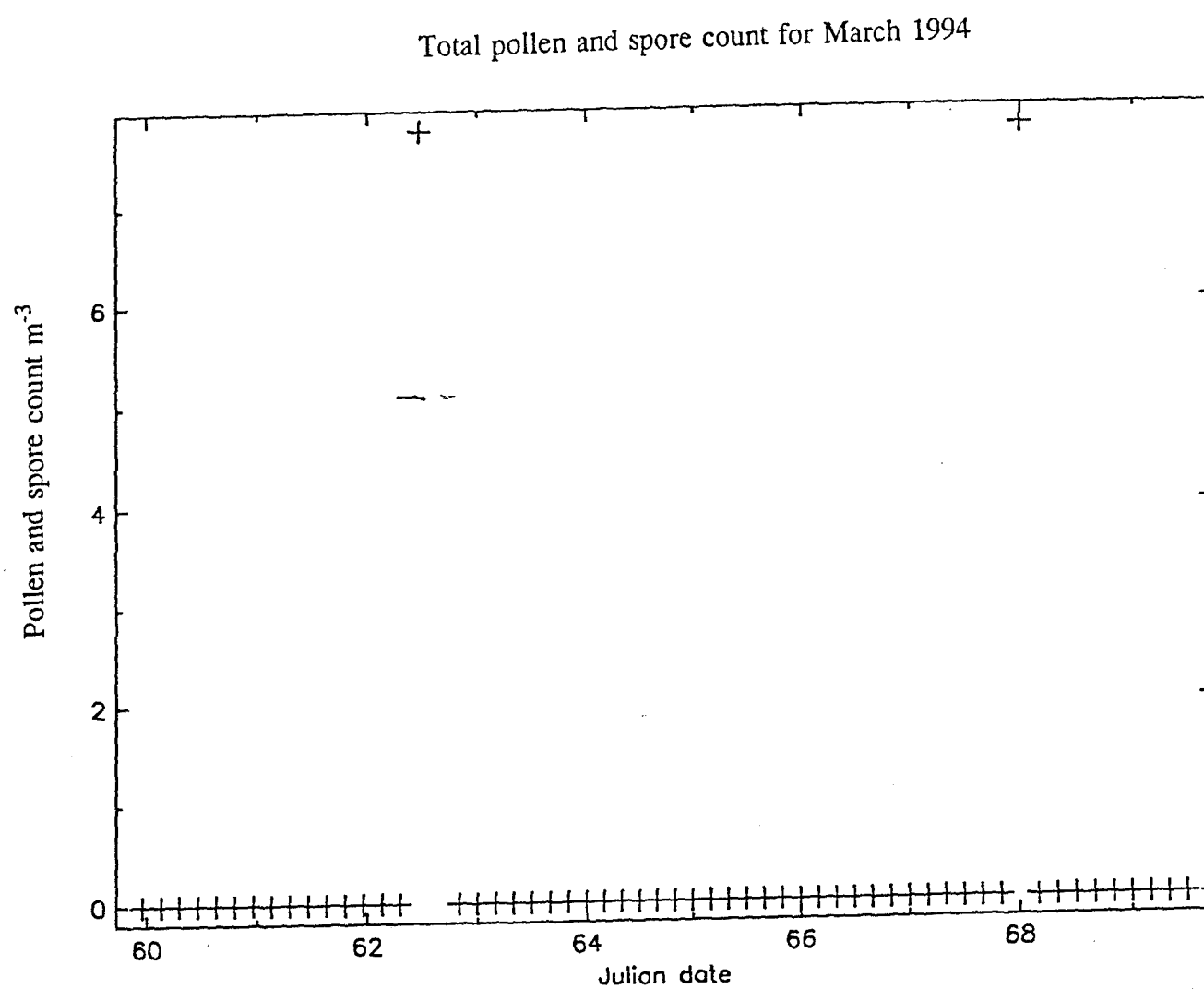
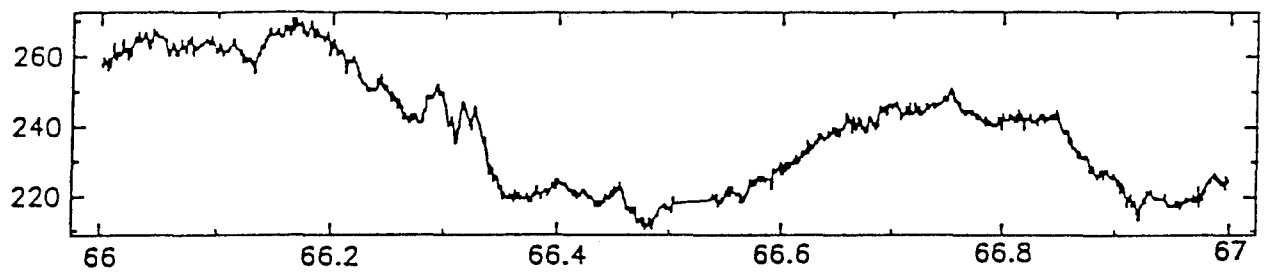


Figure 24(b) Wind direction



4 d back trajectories 925 hPa arriving 7 3 1994 12

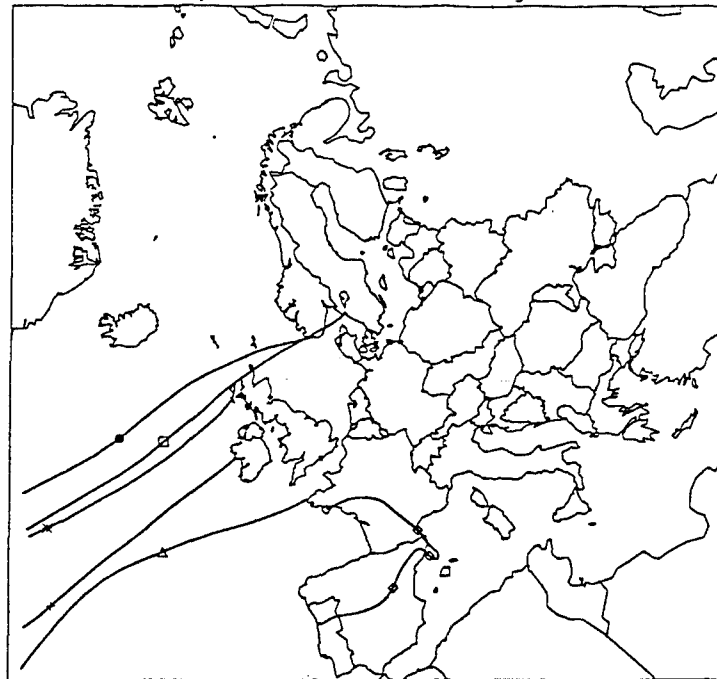


Figure 24(c) Four day back trajectory

Figure 25(a)

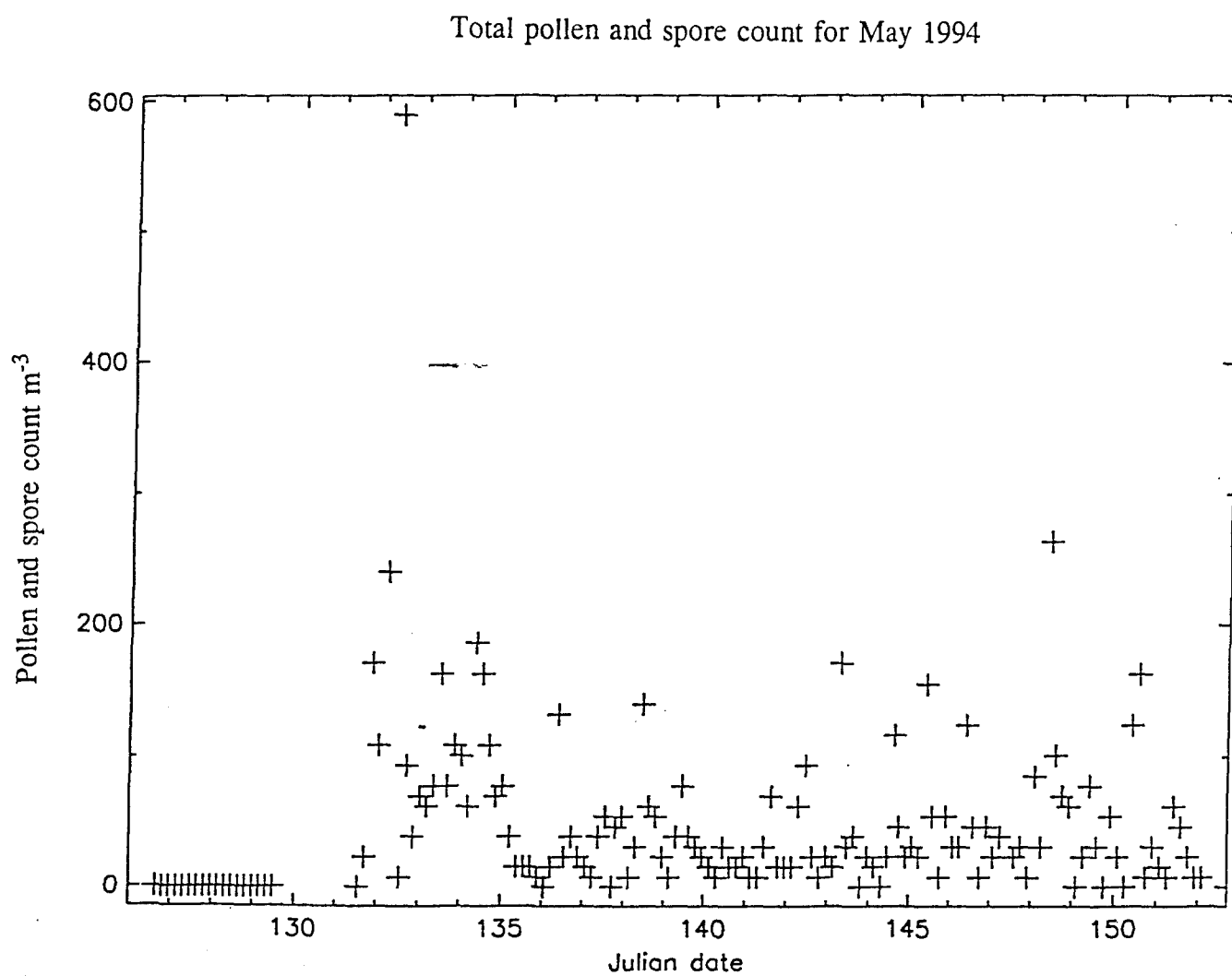
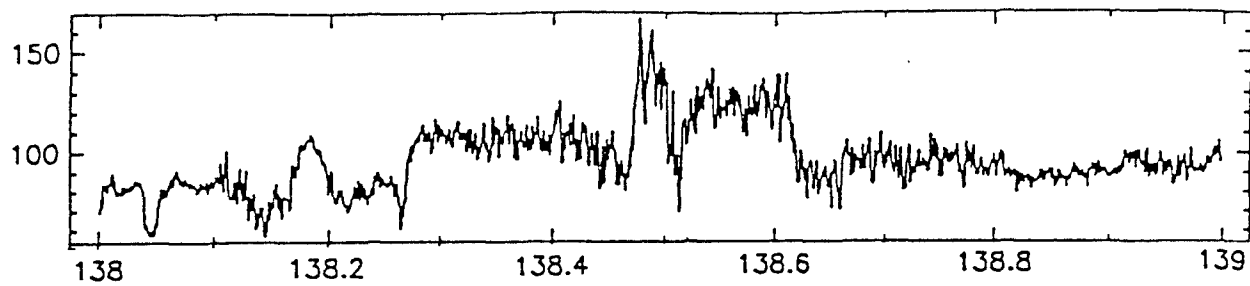




Figure 25(b) Wind direction



4 d back trajectories 925 hPa arriving 18 5 1994 12

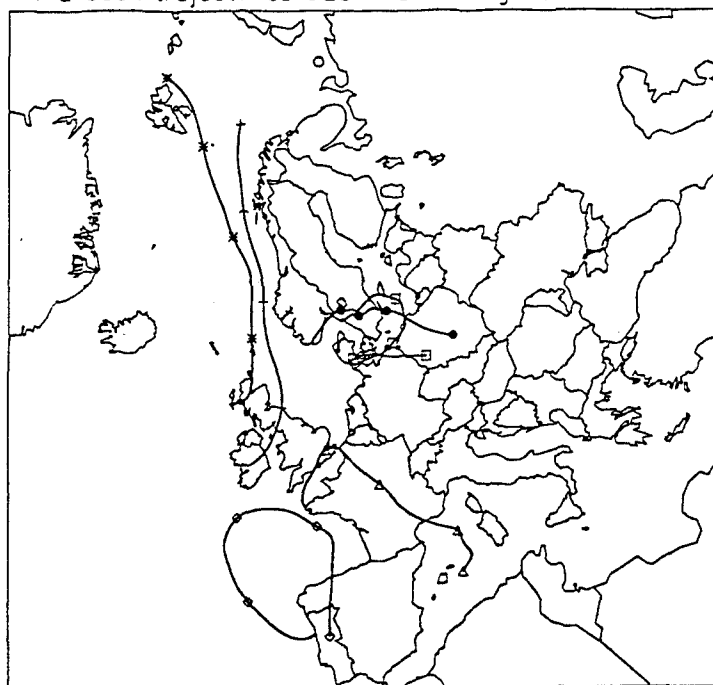


Figure 25(c) Four day back trajectory

Figure 26(a)

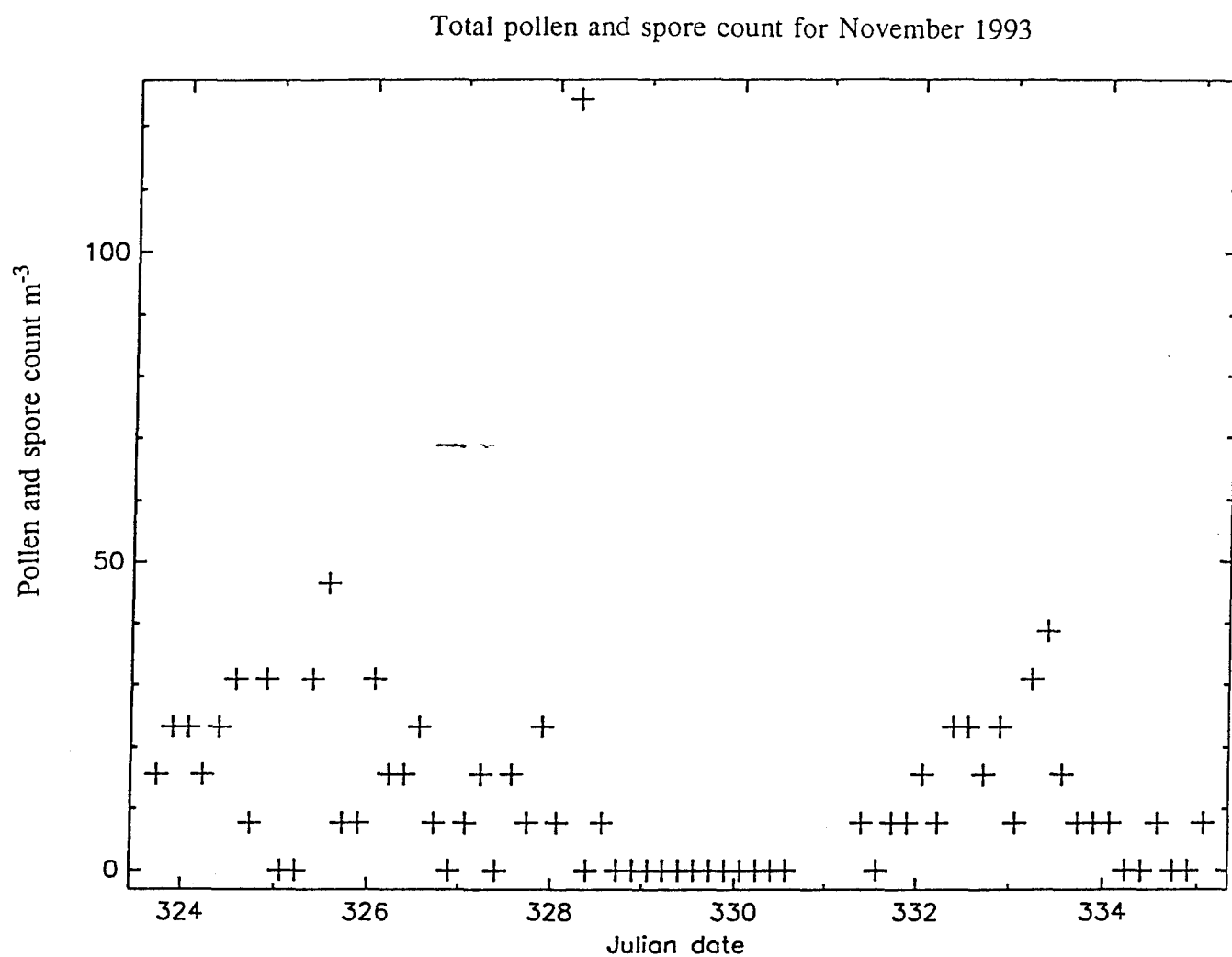
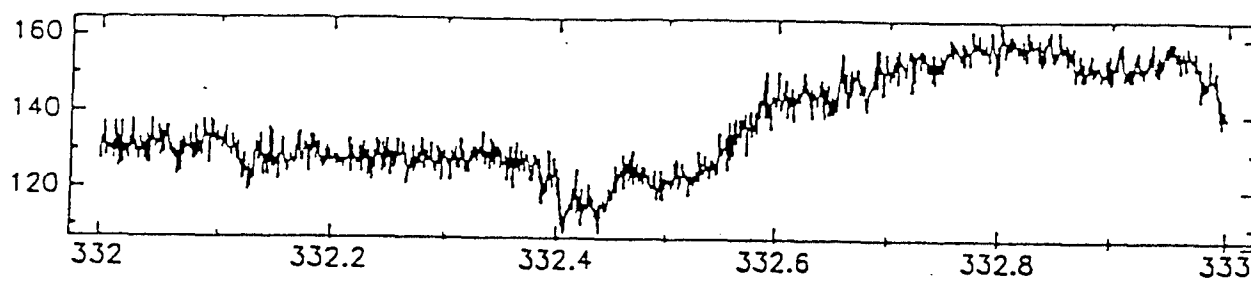


Figure 26(b) Wind direction



4 d back trajectories 925 hPa arriving 28 11 1993 12

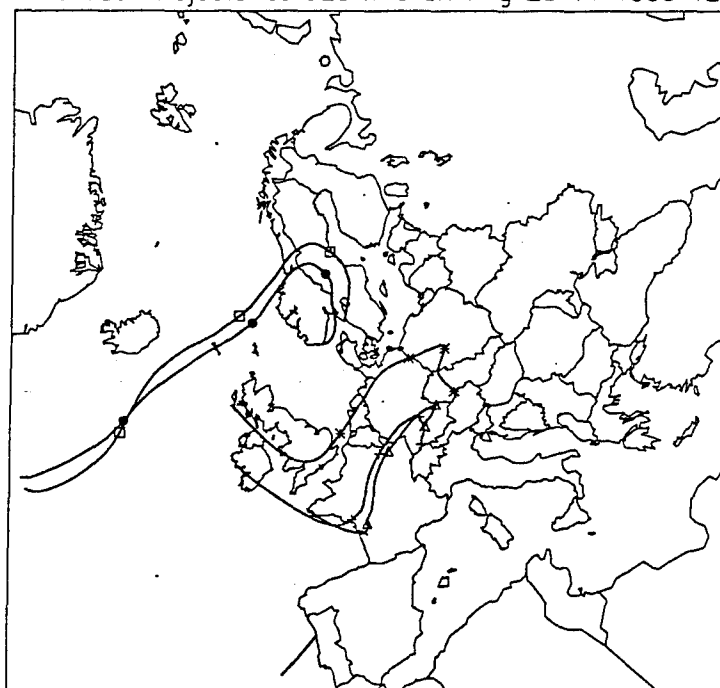


Figure 26(c) Four day back trajectory